Gravatt, Dan

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Subject: Appendices to the Air Monitoring, Sampling and QA/QC Plan
Attachments: Appendix Part 1.pdf; Appendix Part 2.pdf

Attached are the Appendices to the Plan.

Appendix A

Auxier & Associates Radiological Sampling Procedures

PROCEDURE 2.8
PREPARING SAMPLES FOR TRANSPORTATION

1.0 PURPOSE

1.1 To provide guidance for preparing samples for transportation to assure regulatory compliance.

2.0 RESPONSIBILITIES

2.1 The Site Survey Manager is responsible for assuring this procedure is implemented.

2.2 Survey team members are responsible for following this procedure.

2.3 The Health and Safety Committee will assist in preparing appropriate criteria for potential shipments, including specific radiation action levels at appropriate distances from the container's surface.

3.0 PROCEDURE

3.1 Overview of regulations: Regulations for transportation of samples containing small quantities of radioactivity are set forth in 49 CFR 173, Subpart I. The regulations take a graded approach, and shipments containing greater radioactivity will generally be required to follow more stringent shipping requirements

For transportation purposes, radioactive material is defined in 49 CFR 173.403 as "… any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in the table in §173.436 or values derived according to the instructions in §173.433." These activities are reproduced in Table 2.8-1 for a subset of radionuclides.

It is important to note that 49 CFR 173.401(b)(4) states that Subpart I does not apply to "…(n)atural material and ores containing naturally occurring radionuclides which are not intended to be processed for use of these radionuclides, provided the activity concentration of the material does not exceed 10 times the values specified in §173.436."

3.2 Applicability and Additional Considerations: For the purpose of shipping, most samples collected from environmental media, are expected to be either excepted, or classified as non-radioactive for shipping purposes. If the sample shipment

exceeds the limits specified in Table 2.8-1, this procedure does not apply, and special handling will be required.

In addition to requirements imposed by transportation regulations, the analytical laboratory or other receiver of the shipped samples may have further restrictions or requirements which must be considered in preparation of the shipment.

The Health and Safety Committee will assist in preparing appropriate criteria for potential shipments, including specific radiation action levels at the container surface, at 30 cm from the surface, and at 1 m from the surface. Special packaging and labeling instructions will also be developed. This information will be incorporated into the Survey Work Plan.

3.3 The following is the process for preparing samples for transportation:

3.3.1 Select an appropriate outer container for the samples. The container must be strong and capable of retaining contents during conditions normally incident to transportation. A typical container used by A&A is a 48 quart plastic cooler.

3.3.2 Place a plastic liner inside the container. A plastic garbage bag works well.

3.3.3 Place the samples into the lined container. Do not exceed a net sample weight (including the individual sample containers) of 29 kg.

3.3.4 Scan the outside of the loaded container with a gamma detector (Procedure 2.2) to determine the location of the maximum radiation level.

3.3.5 Measure the radiation level (see Procedure 2.4) at a distance of 30 cm from the location on the container identified in Step 3.3. Record the results on the sample chain of custody form.

3.3.6 Compare the measurement obtained with the exposure rate action levels provided in the Survey Work Plan. If the radiation levels satisfy the criteria, the shipment is excepted from all manifesting and labeling requirements.[2] Contact the HSC Chairperson or the project manager if the package still does not meet the specified action levels.

3.3.7 Mark the outside of the inner lining with the UN identification number UN2910. This can be hand written using a black marker.

3.3.8 Fill spaces in the container liner with packing material to restrict sample movement during transport. If the container includes any freestanding

[2] For certain radionuclides, this concentration limit can be demonstrated by measurement of the direct radiation level associated with the package. For example, if the contaminant is oil-field NORM, calculations and experience have shown that the activity concentration limit will be satisfied if the direct radiation level at 30 cm from the package exterior (assuming a typical 48 quart cooler, used by A&A for sample shipping) is less than 20µR/h (or 20 µrem/h), above background. For other radionuclides, the relationship between concentration and direct radiation level may differ from that of Ra-226, and appropriate decision levels must therefore be established for each project.

liquids, include twice the sufficient absorbent material to absorb the liquid contents, in case of leakage.

3.3.9 Seal the inner plastic liner in a manner that leaves the UN number clearly visible.

3.3.10 Place the Chain-of-Custody form and other paperwork on top of the inner liner.

3.3.11 Close and seal the outer container.

3.3.12 Complete shipping papers. If the package is "Exempt", shipping papers are the same as if the shipment did not contain radioactive material.

3.3.13 Attach the shipping papers and initiate the shipment.

Table 2.8-1 Table of Exempt Material Activity Concentrations and Exempt Consignment Activity Limits Found in 49 CFR 173

Symbol of radionuclide [2]	Activity concentration for exempt material (pCi/g)	Parent radionuclide's average activity concentration in exempt package (pCi/g) [3,4]	Activity limit for exempt consignment (pCi)	Activity limit of parent radionuclide for exempt consignment (pCi) [3,4]
Am-241	27	27	2.7E+5	2.7E+5
C-14	2.7E+5	270000	2.7E+8	2.7E+8
Co-60	270	270	2.7E+6	2.7E+6
Cs-137 (b)	270	135	2.7E+5	1.4E+5
K-40	2700	2700 (27000)	2.7E+7	3E+7 (3E+8)
Pb-210 (b)	270	90 (900)	2.7E+5	9E+4 (9E+5)
NORM scale	270	30 (300)	2.7E+5	2E+4 (2E+5)
Ra-224 (b)	270	45 (450)	2.7E+6	5E+5 (5E+6)
Ra-226 (b)	270	30 (300)	2.7E+5	3E+4 (3E+5)
Ra-228 (b)	270	135 (1350)	2.7E+6	1E+6 (1E+7)
Rb(nat)	2.7E+5	3E+5 (3E+6)	2.7E+8	3E+8 (3E+9)
Sr-90 (b)	2700	1350	2.7E+5	1.4E+5
Th-228 (b)	27	4 (39)	2.7E+5	4E+4 (4E+5)
Th-230	27	27 (270)	2.7E+5	3E+5 (3E+6)
Th-232	270	135 (1350)	2.7E+5	1E+5 (1E+6)
Th (nat) (b)	27	3 (27)	2.7E+4	3E+3 (3E+4)
U (nat) (b)	27	2 (19)	2.7E+4	2E+3 (2E+4)
U (enriched to 20% or less)(g)	27	27	2.7E+4	2.7E+4
U (dep)	27	27	2.7E+4	2.7E+4

1 69 FR 3685, Jan 26, 2004

2 +D indicates the sum of the activities of the parent and specified daughters should be compared to exempt values

3 Derived values account for presence of daughters and incorporate 10x modifier for natural origin, if applicable.

PROCEDURE 3.7
ENVIRONMENTAL SAMPLE IDENTIFICATION

1.0 PURPOSE

1.1 To assure consistent sample identification.

2.0 RESPONSIBILITIES

2.1 The Corporate Secretary (or designated agent) is responsible for maintaining a list of site identification codes that have been used in the past or are in current use.

2.2 The Project Manager is responsible for selecting site identification code(s) appropriate for new site(s) and assuring that the site identification codes are unique.

2.3 The Site Survey Manager is responsible for selecting grid identification numbers, and developing a system for relating the grid identification numbers to an appropriate land survey convention.

2.4 The Site Survey Manger is responsible for assuring that this procedure is implemented.

2.5 Survey team personnel are responsible for following this procedure.

Note: The Site Survey Manager may modify any part of this identification system as needed in order to facilitate field work in a given situation, provided that no ambiguous sample numbers are produced in the process. The Site Survey Manager should keep departures from the standard format to a minimum, and is responsible for overseeing all consequent modifications to data handling/processing software and procedures that may be required by such modifications.

3.0 PROCEDURE

3.1 Field samples shall be identified by an alphanumeric code. This code shall be used on the sample container, on the chain-of-custody forms, and in the field records.

3.2 The general format of the code is typically: XXXXXXY123. Where:

3.2.1 **XXXXXX**= Four to six letter site identification code identified in Step 2.2, above.

3.2.2 **Y**= A one-digit code indicating the medium protocol.

A: Air
D: Sediment
R: Smears
S: Soil (including amorphous materials found in the soil, earthen or not)
V: Vegetation
W: Water
X: Misc. Not covered above

3.2.4 **123**= alphanumeric characters (usually 3) indicating the particular number of a particular sample type or general category for the site. Each number will correspond to a location designation on a map or grid area. Additional characters may be included to further identify location such as depth of sampling.

3.2.5 Examples of some sample codes are:

RFYCTGS143-the 143rd soil sample collected for project RFY/CTG

RFYCTGS187.090-a soil sample from the 90 cm depth at location 187 for the project RFYCTG

GIBONMW001-the first water sample collected for project GIB/ONM

3.3 At a minimum, sampling date, sampler initials and the sample identification are placed on the sample.

3.4 The identification method for the project should be described in the project records.

3.5 Marking is performed using an indelible pen.

3.5 All samples known or suspected of containing levels of radioactivity, which could present a contamination or exposure problem, are to be placed in clean outer

containers and clearly marked with descriptive information, as appropriate, according to the sample screening requirements.

PROCEDURE 3.8
SAMPLE CHAIN-OF-CUSTODY

1.0 PURPOSE

To provide a method for sample chain-of-custody.

2.0 RESPONSIBILITIES

2.1 The Site Survey Manager is responsible for assuring that this procedure is implemented.

2.2 Survey team members are responsible for following this procedure.

3.0 PROCEDURE

Chain-of-custody is initiated upon collection (or receipt) of samples and continues until samples are transferred to another organization or are disposed. An acceptable chain-of-custody is maintained when the sample is under direct surveillance by the assigned individual; the sample is maintained in a tamper-free container; or the sample is within a controlled-access facility. The chain-of-custody is recorded on a standardized A&A form (see Appendix A) or a form provided by another organization, such as an analytical laboratory or another sampling agency.

3.1 Field Procedures

3.1.1 An individual present during sample collection is designated as the sample custodian and is responsible for maintaining surveillance of the sample until the custody of that sample is transferred to another party. Samples must, at all times, be in the possession and under the direct surveillance of the sample custodian, or secured in a locked vehicle, building, or container. The sample custodian initiates a chain-of-custody form, daily, for all samples collected or received on that day.

3.1.2 Samples may be listed on the form as an individual entry or group of samples having common characteristics and originating from the same site may be recorded as a single entry, provided information describing each sample in the group (e.g. a completed field data form) is attached to or referenced on the custody form.

3.1.3 If sample custody is to be transferred (relinquished), the container and its contents are inspected by the individual accepting custody to assure that tampering has not occurred and custody has therefore been maintained. If evidence of tampering is observed or if any deviations or problems are noted, a notation must be provided on the form by the individual accepting custody. The sample collector must sign the first "Relinquished by" block and the receiver must complete the first "Received by" block.

3.1.4 If sample custody will not be assured under one of the conditions in item 3.0 above, a security seal is placed on the container of the samples. A security seal is a wire, tape, or other such item, which is uniquely identified (numbered), and can be affixed to a package in a manner as to require damaging the seal if the package is opened. Damage to the seal thereby alerts the recipient of a package to the possibility of tampering with the contents. The number of the seal is entered onto the Chain-of-Custody form. Samples, which are under security seals, do not have to be maintained in a secure area; however, precautions should be taken to restrict sample access to authorized individuals.

3.1.5 The original of the chain-of-custody form must contain all signatures and other pertinent records regarding custody. Therefore the original is retained in the possession of the individual who has custody.

3.1.6 As long as samples remain in custody of the sampler, both copies of the chain-of-custody form are to accompany the samples. If custody is transferred to another individual and the control requirements in item 3.0 above are not satisfied, the duplicate copy of the form is packaged with the samples and the original remains with the individual having custody.

3.1.7 Samples collected by other organizations and provided to A&A personnel will have chain-of-custody initiated for them by the individual receiving the samples. When the organization has an established chain-of-custody in place, a copy of the form will be attached to the A&A form.

3.2 Sample Transport

3.2.1 Samples must comply with regulations of the Department of Transportation, if they are to be transported over or through publicly accessible transport routes. The Health and Safety Plan describes the procedure for assuring compliance with this requirement.

3.2.2 Unsealed samples may be transported by a vehicle controlled by the person having custody of the samples, or in that person's hand carried baggage.

3.2.3 Transport by mail, checked baggage, common carrier, or other mode not controlled by the sample custodian of record, requires that security seals be used.

3.2.3 The method of transport is to be identified on the original chain-of-custody record. If inner containers are sealed, additional seals on outer packaging are not required.

3.3 Samples sent to other organizations

3.3.1 The custodian will sign the "Relinquished by" space and the original form will be packed with the samples.

3.3.2 Receiving organizations will be requested to check the container and its contents for signs of tampering and note any deficiencies in the "Comments" portion of the form.

3.3.3 When samples will not be returned to A&A, the receiving organization will be asked to return the original of the form. The form will be provided to the Project Manager, for inclusion with the project records.

3.3.4 If samples will be returned to A& A, the receiving organization will be asked to sign the "Relinquished by" space and pack the form with the samples for return shipment. Upon receipt, the samples and form will be provided to the Project Manager, who will sign the "Received" space and place a copy in the project file.

PROCEDURE 3.9
AIR SAMPLING

1.0 PURPOSE

This procedure establishes the basis and methodology for the placement and use of air monitoring equipment, as well as the collection, analysis, and documentation of air samples. Radiological air sampling and analysis is performed to monitor concentrations of radionuclides in the air for purposes of tracking internal radiation exposure to occupational radiation workers, determining appropriate respiratory protection devices, establishing radiological posting boundaries, verifying effluent airborne radioactivity concentrations, providing information on radiological conditions in the work area, and environmental monitoring.

2.0 RESPONSIBILITIES

2.1 Radiation Safety Officer (RSO)

- Manages the implementation of this procedure.
- Ensures technicians performing activities under this procedure are competent and have sufficient experience to perform assigned tasks.
- Ensures all activities performed within this procedure conform to the requirements of the SSHP.

2.2 Senior Radiation Protection Technician (SRPT)

- Initiates, collects, submits, counts, and documents air samples according to the requirements of this procedure, and the SSHP.
- Ensures that junior level technicians have sufficient experience and / or knowledge to perform assigned duties under this procedure.

3.0 MATERIALS

- Filters
- Envelopes or folders
- Chain of Custody
- Checklist (Attachment 3)

NOTE: Assembly, installation and calibration of sampling stations are performed according to manufacturer instructions and specifications.

4.0 DEFINITIONS

Airborne Radioactivity: Radioactive material in any chemical or physical for that is dissolved, misted, suspended, or otherwise entrained in air.

Breathing Zone (BZ): A uniform description of the volume of air around the worker's upper body and head which may be drawn into the lungs during the course of breathing.

Derived Air Concentration (DAC): The concentration of a given radioactive nuclide in air which, if breathed by the reference man for a working year of 2000 hours under conditions of light work (1.2 m3 of air per hour), would result in an intake of one (1) ALI.

DAC-hour (DAC-hr): The product of the concentration of radioactive material in air (expressed as a fraction or multiple of the DAC for each radionuclide) and the time of exposure to that radionuclide in hours. A facility may take 2000 DAC-hr to represent 1 ALI.

Grab Sample: A single sample of ambient air collected over a short time.

Monitoring: The measurement of radiation levels, airborne radioactivity concentrations, radioactive contamination levels, quantities of radioactive material, or individual doses and the use of the results of these measurements to evaluate radiological hazards or potential and actual doses resulting from exposures to ionizing radiation.

Representative: Sampling in such a manner that the sample closely approximates both the amount of activity and the physical and chemical properties of the material (e.g., particle size and solubility in the case of aerosol to which workers are exposed). Air sampling performed within the Breathing Zone (BZ) is considered representative of the airborne radioactive material concentration inhaled by the worker.

SSHP: Site specific health plan.

5.0 PRECAUTIONS AND LIMITATIONS

- Running air samplers for extended periods may cause excessive dust loading of the filter media. The frequency of filter change-out should be increased if excessive dust loading is observed.
- Air samplers shall not be used in combustible / explosive atmospheres.
- Air sampling and sample counting equipment shall not be operated beyond their respective calibration periods.
- Air samples shall be taken in such a manner as to not contaminate the filter with materials that were not airborne during the sample interval or by re-suspension of loose contamination from surfaces near the sampling head.
- Sampler exhaust may cause the re-suspension of loose surface contamination if the sampler is positioned improperly.
- Consider higher volume air samplers when covering short duration tasks.
- The decision to provide individual monitoring devices to workers is influenced by the expected levels of intake, likely variations in dose among workers, and the complexity of measurement and interpretation of results.

- Operating instructions for air sampling equipment and calibration functions are addressed in separate instrument-specific procedures.
- Use only those supplies, attachments, replacement parts, or accessories recommended for use with the particular air sampler with which you are working.
- Turn air sampler OFF when loading, unloading, attaching or removing filters or accessories.
- Do no operate air sampler without a filter or other recommended sampling accessory. Make certain that filters do not become overly saturated to restrict air flow or break up during operation.
- Unplug from outlet when not in use and before cleaning or servicing. Grasp plug, no cord when disconnecting air sampler from outlet.
- Do not operate an air sampler with a damaged cord or plug or after the sampler malfunctions or has been damaged in any manner.

6.0 PROCEDURE

6.1 Air Monitoring Methods

6.1.1 Utilize the following monitoring methods to implement the radiological air monitoring program:

- General Area (GA) Air Monitoring
- Breathing Zone (BZ) Air Monitoring
- Passive Radon Monitoring
- Particulate Radon Grab Samples
- Perimeter Monitoring, frequently referred to as Air Environmental (AE)

6.1.2 Air sampling equipment should be placed so as to:

- Not directly contact a contaminated (transferable) surface.
- Minimize interference with the performance of work.
- Be easily accessible for changing filters and servicing.
- Be downstream of potential release points.
- Minimize the influence of supply airflow.

6.1.3 An airflow study of any indoor area to be monitored should be performed prior to placement of the sampler (other than BZ samplers). Additional studies should be performed after changes in the work area setup, ventilation systems, or seasons, if seasonal changes may affect airflow patterns.

6.1.4 Perform BZ air sampling in occupied areas where, under typical conditions, a worker is likely to be exposed to an air concentration of 10 % or more of the DAC.

6.2 General Area (GA) Air Sampling

6.2.1 GA samples are typically taken with low volume samplers such as LV-1 or equivalent.

6.2.2 GA sampling shall be performed with instrumentation operating at volumes capable of meeting the analytical Minimum Detectable Concentration (MDC).

6.2.3 GA samples should be collected:

- During work activities as a supplement to Breathing Zone (BZ) sampling as deemed appropriate.
- At site boundaries to confirm effluent air discharge concentrations. These are the Air Environmental (AE) type samples.
- At discharge points to determine the worst case airborne radiological conditions.

6.2.4 Document airflow studies, if performed in the appropriate project logbook or as directed by the RSO.

6.2.5 Select a calibrated low / high volume sampler with the appropriate glass fiber air filter and place the sample head into position. The fuzzy side of the filter should face outwards.

6.2.6 Turn the sampler ON. At a minimum, document the following information on the air filter envelope and checklist (record NA for any items on the checklist that do not apply, Attachment 3):

- Sampling Location
- Date / time on
- Sampler model
- Serial number
- Filter ID number
- Sample Purpose (eg GA or AE)
- RWP if applicable
- Flow rate
- On by (individual starting sampler)

6.2.7 When air monitoring is complete, observe the sampler flow rate and turn the sampler off. At a minimum, document the following information on the air filter envelope and checklist (Attachment 3):

- Date / time off
- Flow rate
- Total Run Time (if available)

- Total Volume Sampled
- Off by (individual terminating sample)

6.2.8 Remove and / or replace the sample head and filter using caution to prevent cross contamination.

6.2.9 Store the filter in a protective container to minimize the loss of collected material.

6.2.10 Submit sample and associated sample specific information to the counting lab for analysis.

6.3 Breathing Zone (BZ) Air Sampling

6.3.1 Collect BZ samples during entries into posted airborne radioactivity areas and during activities which have a reasonable potential of producing airborne radioactivity (e.g., excavating contaminated soils, surface destructive activities on surfaces with fixed contamination) as determined by the RSO.

6.3.2 Position the sampler on the individual representative of the worst-case exposure for the group if a single lapel sampler is used for multiple members of a work group. In micro environments such as the interior of an operator cab, the placement of the sampler may be in any representative location that does not interfere with the safe operation of the equipment. Base this selection on operating experience and consultation with the RSO. A single lapel sampler should be used for a group of no more than four workers spending greater than one hour in the work area under the same RWP.

6.3.3 Ensure the sample head is positioned as close to the breathing zone as practical without interfering with the work or the worker.

6.3.4 Operate sampler(s) according to the appropriate instrument use procedure. At a minimum, document the following information on the air filter envelope or log sheet:

- Primary Wearer’s name(s) and/or site badge number
- Sample Purpose (eg BZ)
- (RWP) number
- Sampler model / serial numbers
- Date / time On
- Flow rate (sampler must be running)
- On by (individual starting sampler)

6.3.5 Upon exit from the work area, note the flow rate, turn the sampler OFF and detach from the worker / object. Note that unless otherwise authorized by the RSO. BZ sampling should be suspended / restarted during the workday to facilitate break period when no one is in the work area. Accurate volume tracking is crucial during these periods of non-operation.

6.3.6 Perform necessary post-operation sampler checks according to the specific instrument use procedure

6.3.7 Carefully, remove the air filter from the sample head and place in air filter envelope. Complete the pre-printed air filter envelope or sample log sheet:

- Date / time off
- Flow rate
- Total Run Time (if available)
- Total Volume (if available)
- Off by (individual stopping sampler)

6.3.8 Submit sample to Counting Room for analysis.

6.4 Radon and Thoron Progeny

6.4.1 High volume or low volume grab samplers such as HV-1, LV-1, or RAS 1 (typically in the 35-75 lpm range) should be used for collecting radon and thoron samples.

6.4.2 Radon and thoron samples should be collected:

- During work activities as deemed appropriate by the RSO or designee.
- At restricted area boundaries as deemed appropriate by the RSO or designee.
- Each frequently occupied work location should have its own samplers.
- Airflow patterns should be considered in placing samplers so that the sampler is likely to be in the airflow downstream of the source.
- A simultaneous background sample shall be taken upwind of all activities when radon and thoron sampling is performed. This sample is critically important.
- When collecting a radon and thoron breathing zone sample, the sampler should be located in the breathing zone for the worker. Preferably it should be held immediately downwind of the worker and moved around with the worker.

6.4.3 Select a calibrated high volume sampler with a 47 mm filter and place the sample head into position. The preferred filter is a membrane filter. The approved membrane filter is the F&J Specialty Products, Inc. model number A020A047A. Alternatively, a glass fiber filter is the F&J Specialty Products, Inc. model number FP-47.

6.4.4 Turn the sampler ON and complete the required information on the air filter envelope to include:

- HWP number, if appropriate
- Sampler model and serial number
- On date, time, and flow rate
- On by (site worker initials)
- Sample location

6.4.5 Collect a sample for exactly 5 minutes, with no more than a 5-second uncertainty. Exercise caution when handling sample head so as not to cross contaminate the air filter.

6.4.6 Remove air filter from sample head and place in air filter envelope. Complete the required information on the air filter envelope including:

- Off date, time, and flow rate
- Site worker stopping the sampler

6.4.7 Submit the sample to the counting room within 30 minutes after collection. Samples must be counted between 40 and 90 minutes, or they will be void.

6.4.8 Analyze the sample in accordance with Sections 8.1 or 8.2, whichever is appropriate

6.4.9 Alternate industry-accepted methods for radon-thoron monitoring may be used at the discretion of the RSO with concurrence from the Project Certified Health Physicist.

6.5 Perimeter/ Environmental Air (AE) Sampling

6.5.1 Perimeter Environmental Air samples are taken with high volume samplers such as the Staplex TFIA, Radeco H809v or equivalent. Low volume air samplers such as the LV-1 may be used at the discretion of the RSO

6.5.2 AE samples are collected to verify compliance with off-site release criteria.

6.5.3 AE samples are collected at locations designated by the RSO. At least four perimeter air-sampling stations are positioned along excavation boundaries and one sampler is to be placed at a designated background reference location. One air sampling station will be established at the most likely downwind perimeter boundary, as determined by evaluation of local meteorological data, and / or the nearest perimeter boundary from active work areas.

6.5.4 Filters from operating perimeter air samplers are normally changed out after one to four weeks of operation depending on the dust loading and associated sampler performance capabilities. Filter change-out of perimeter air samplers will be performed at a frequency long enough to ensure acceptable counting statistics and short enough to maintain consistent sampler flow rates.

6.5.5 Perimeter sampler operation shall be verified on a daily basis around locations when airborne generating activities are in progress. This requirement may be relaxed by the RSO for samplers with data logging capability.

6.5.6 Document daily verification (i.e., flow rate) and notify the RSO of any discrepancies. Replace filter and investigate pump operation if daily flow rates vary by greater than 20%.

6.5.7 Any sampler that is out of service due to malfunction for more than 1 hour and any invalid samples should be brought to the attention of the RSO.

6.5.8 Samples are to be collected in accordance with Section 6.2, Steps 5-10.

6.6 Passive Radon Monitoring

6.6.1 Passive radon monitoring methods include the use of either alpha track etch detectors or electrets.

6.6.2 Detectors should be placed for a length of time, so that the minimum detectable concentration is 0.1pCi/l or less, following manufacturer guidelines. The length of placement is generally 1 month or greater. Locations selected should be representative of the breathing zone, when practical. A simultaneous background sample should always be taken at a location unaffected by site activities. This sample is critically important.

6.6.3 Open the bag containing the detector and place the detector in a protective container to allow for air circulation. Follow manufacturer guidelines to activate the detector, as necessary.

6.6.4 Record in the logbook:

- Sample location
- Date and time of placement
- Serial number of the detector
- Initials of the worker placing the detectors

6.6.5 Ship the detector to the manufacturer's processing center for analysis.

7.0 ANALYSIS OF AIR SAMPLES

General Area (GA), Breathing Zone (BZ), and Air Environmental (AE) samples should be submitted to the counting room for gross alpha analysis. Samples may be analyzed for gross alpha/ beta activity onsite or sent offsite for isotopic analysis as deemed appropriate by the RSO.

7.1 Analysis for Radon and Thoron Progeny from a 5-Minute Low Volume Grab Sample

7.1.1 Count the sample twice (5 minutes each) for alpha activity using a Ludlum 2929, Ludlum 2000, or Equivalent.

1. The first count should start at least 40 minutes after the end of the sample, but not greater but not greater than 90 minutes at the end of sample collection.

2. The second count should start at least 5 hours after the end of the count, but not greater than 17 hours after the end of the first count.

NOTE

It is not recommended to use a gas flow proportional counter for this analysis if there is a reasonably high probability of contaminating the instrument with radon and / or thoron progeny.

8.1.2 Calculate the thoron progeny (TDC) in working levels from the delayed (second) count as follows:

cpmnet = (gross counts/count time) - background cpm of counting instrument
V = Volume of air in liters
E = efficiency of counting instrument
CE = Filter collection efficiency (normally 0.998)
SAF = Self absorption factor (normally 0.7 for glass fiber filters and 1.0 for membrane filters)
FTh = Working level factor from Graph 1 (Attachment 1).

8.1.3 Calculate the radon progeny (RDC) in working levels from the first count as follows:

$$RDC = \frac{\left(\frac{cpm_{net}}{E \cdot V \cdot CE \cdot SAF} - TDC\ x16.5 \right)}{F_{Rn}}$$

where,

cpmnet = (gross counts/count time) - background cpm of counting instrument
V = Volume of air in liters
E = efficiency of counting instrument
CE = Filter collection efficiency (normally 0.998)
SAF = Self absorption factor (normally 0.7 for glass fiber filters and 1.0 for membrane filters)
FRn = Radon working level factor from Graph 2 (Attachment 2).
TDC = Thoron progeny determined from second count

8.2 Alternate Method for the Analysis of Radon Progeny from a 5 Minute Low Volume Grab Sample

This section only applies to the determination of radon and not the determination of thoron.

8.2.1 Count the sample once for alpha activity using a Ludlum 2929, Ludlum 2000, or Equivalent. The count should start at least 40 minutes after the end of the sample, but not greater than 90 minutes at the end of the count. Count the sample for 5 minutes.

NOTE

It is not recommended to use a gas flow proportional counter for this analysis if there is a reasonably high probability of contaminating the instrument with radon and / or thoron progeny.

8.2.2 Calculate the radon progeny (RDC) in working levels from the first count as follows:

$$RDC = \frac{cpm_{net}}{E \cdot V \cdot CE \cdot SAF \cdot F_{Rn}}$$

where,

cpmnet = (gross counts/count time) - background cpm of counting instrument

V = Volume of air in liters
E = efficiency of counting instrument
CE = Filter collection efficiency (normally 0.998)
SAF = Self absorption factor (normally 0.7 for glass fiber filters and 1.0 for membrane filters)
FRn = Radon working level factor from Graph 2 (Attachment 2).

8.0 REPORTS

Maintain air monitoring instrument data, sampling data, and analysis results as a quality record.

9.0 ATTACHMENTS

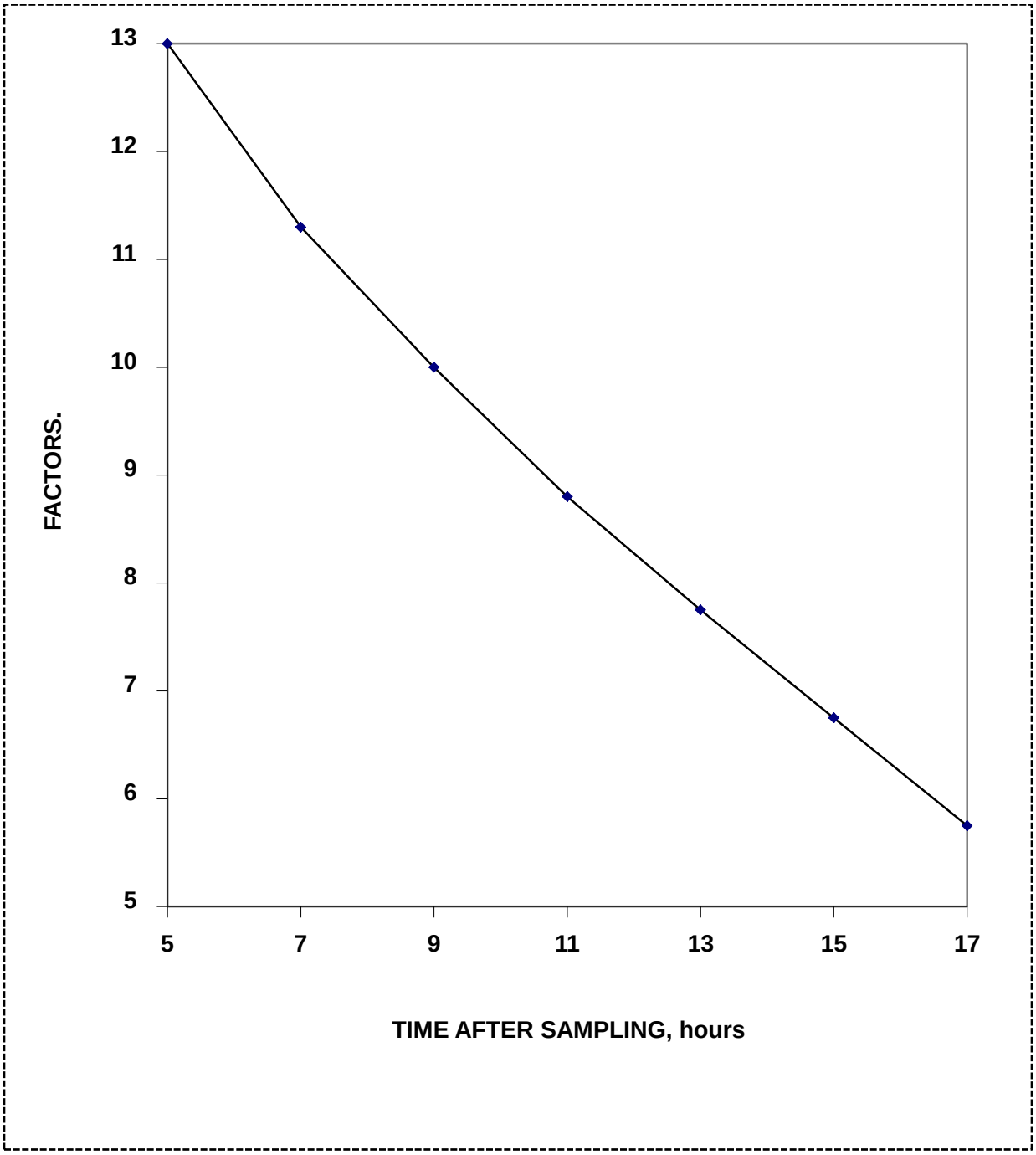
Attachment 1 Graph 1, Thoron Working Level Factors

Attachment 2 Graph 2, Radon Working Level Factors

10.0 REFERENCES

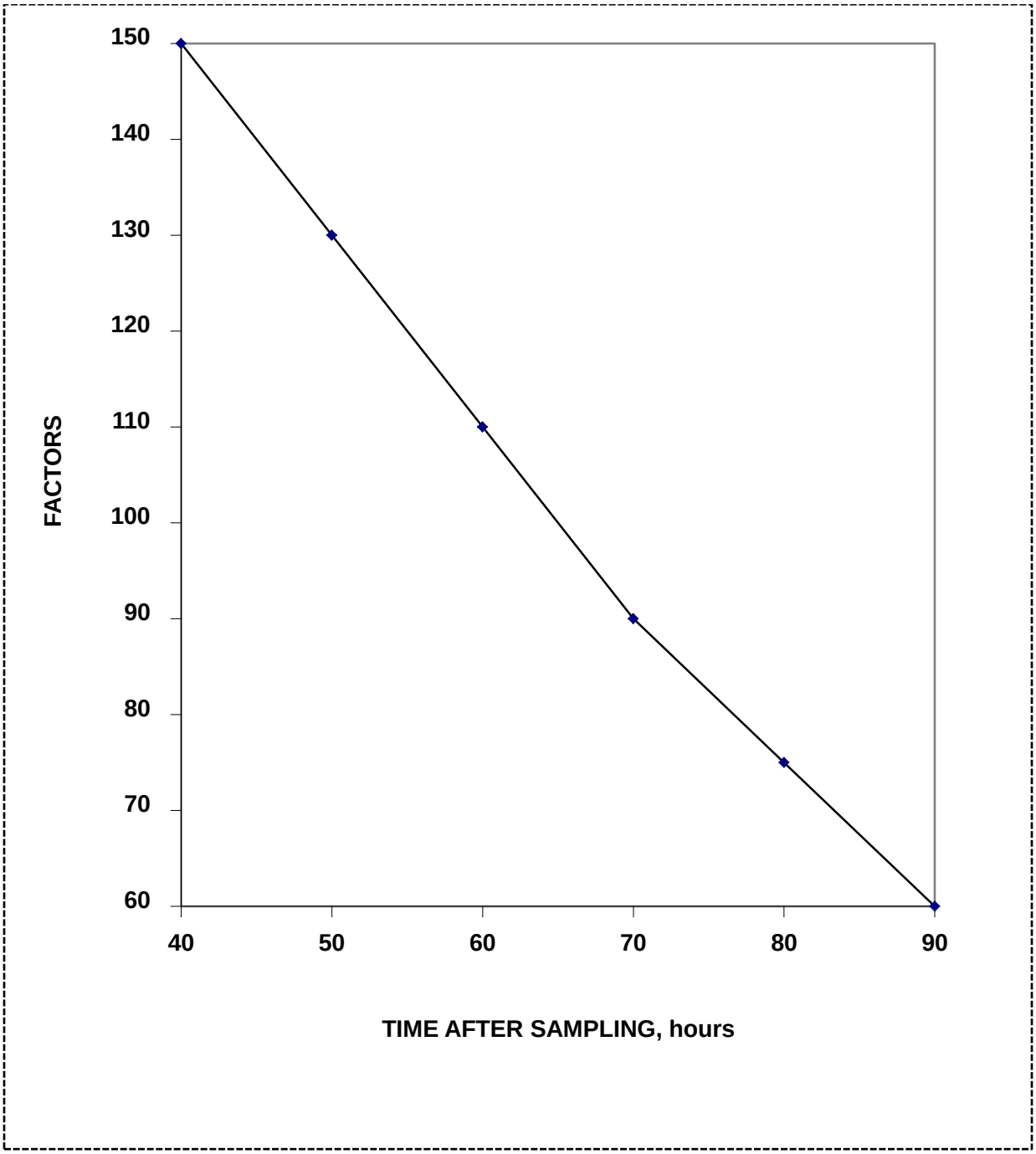
- 10 CFR 20, "Standards for Protection Against Radiation."
- Rock, R.L., Sampling Mine Atmospheres for Potential Alpha Energy Due to the Presence of Radon-220 (Thoron) Daughters, Informational Report No. 1015, United States Department of the Interior, Mining Enforcement and Safety Administration, 1975.
- Kusnetz, H.L., Radon Daughters in Mine Atmospheres, A Field Method for Determining Concentrations, Am. Ind. Hyg. Assoc. Quat., Vol. 17, No. 87, 1956.
- ANSI N13.1, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities.
- Regulatory Guide 8.25, Air Sampling in the Workplace.
- 29 CFR 1910.1096, United States Occupational Health & Safety, Ionizing Radiation.

ATTACHMENT 1
GRAPH 1, THORON WORKING LEVEL FACTORS



Time factors versus time after sampling for thoron daughter samples.

ATTACHMENT 2
GRAPH 2, RADON WORKING LEVEL FACTORS



Time factors versus time after sampling for radon daughter samples.

Air Sampling Checklist

Location: _____ Filter #: _____

Sampler ID: _____ Sample Start Date/Time: _____

Sampler SN: _____ Sample End Date/Time: _____

Flow Rate: _____ Elapsed Time: _____

Technician: _____

Instrument Inspection Checklist

Supplies and Materials

Filters (Inspect filters with a back light to look for pin holes)	Yes	No	
Envelopes or folders for filters	Yes	No	
Media fluid	Yes	No	
Calibration Kit and procedure	Yes	No	
Log book	Yes	No	
Chain of Custody	Yes	No	

Sampler Operation

			Comments
Is the sampler running?	Yes	No	
If sampler is not running, contact management.			
Is the filter loading heavy?	Yes	No	

Visual Check

Is the sampler level and securely mounted?	Yes	No	
Any visible damage to sampler or shelter?	Yes	No	
If yes, contact management.			
Power cords and connections in good condition?	Yes	No	
Tubing and connections in good condition?	Yes	No	
Filter holder assembly in good condition?	Yes	No	
PM 2.5 filter cartridge in good condition?	Yes	No	
Inspect and clean filter screen?	Yes	No	
Do gaskets need to be replaced?	Yes	No	
Constant flow controller operational?	Yes	No	
Elapsed time meter operational?	Yes	No	
Telemetry unit powered up and operational?	Yes	No	

Appendix B
Eberline Analytical Oak Ridge Laboratory Quality Assurance Program Manual

Eberline Analytical
Oak Ridge Laboratory
Quality Assurance Program Manual

AUTHORIZATION AND APPROVAL STATEMENT

This **Eberline Analytical** - Oak Ridge Laboratory,
ñQuality Assurance Program Manualò
is authorized and approved in its entirety by:

Saba Arnold Seaver
Quality Assurance Manager

Date: August 1, 2013

Michael R. McDougall
Laboratory Manager

Date: August 1, 2013

Eberline Services – Oak Ridge Laboratory
601 Scarboro Road
Oak Ridge, TN 37830
Phone: (865) 481 - 0683, Fax: (865) 83 - 4621

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MISSION STATEMENT

Our mission is to ensure that all of The Eberline Services, Oak Ridge Laboratory's systems, services, processes, and deliverables are of a quality that meets or exceeds client requirements; and to foster a Laboratory culture in which there is a commitment to a rising standard of quality. This culture demands that the quality of those systems, services, processes, and deliverables and the methods used to achieve that quality be continuously improved.

Quality Assurance is a spirit that pervades all aspects of an organization. It is the quality attitude developed by a quality culture in an organization. It is the spirit in which any organization, procedure or activity is documented, implemented and performed. This spirit produces empowerment and motivation in all employees to achieve the highest level of quality. The result of this attitude is **"Quality Assurance."**

The policy guidelines are presented in this Oak Ridge Laboratory Quality Assurance Program Manual, and are based on the philosophy and premises that:

- People are our greatest asset and are ultimately responsible for the quality of the items and services we provide. Therefore, each person is treated with the greatest possible respect and consideration.
- Employees are inherently proud and want to produce top quality and on time services and deliverables. In order to do this they must be made aware of the quality requirements that are expected and must be provided appropriate facilities, equipment, and proper training.
- A culture of quality embodied within the entire Oak Ridge Laboratory organization is the most effective way to provide support for the employee's commitment to quality.
- Management support is paramount, and organizational responsibilities must ensure integration of quality requirements in the day-to-day operations.
- All systems, services, processes, and deliverables can be planned, performed, assessed, and improved.
- Improvements allow operations to become more efficient and result in contractual requirements performed "on time" and done "right the first time."
- Quality improvements lead to reduced costs and allow the ultimate objective of providing the highest quality items and services to be a viable goal.

Quality is our clientôs perception of us. Our actions must assure our clients that the Oak Ridge Laboratory organization provides for quality systems, services, processes, and deliverables that will meet or exceed their requirements. To this end, each employee must understand and exercise the highest standards of ethics in the performance of their duties and ensure the integrity of the data they report.

STATEMENT OF COMPLIANCE AND MATRIX COMPARISON

This Quality Assurance Program Manual addresses the basic requirements outlined in several regulatory manuals, standards, regulations, and national laboratory programs. Matrix comparison to some of these documents is included in the following pages. Additional regulatory requirements are listed in Section 1.0.

NQA-Quality Assurance Requirements for Nuclear Facility Application
National Environmental Laboratory Accreditation Conference (NELAC), USEPA; 2003, the NELAC Institute (TNI), 2009
USEPA Requirements for the Certification of Laboratories Analyzing Drinking Water; 2005
ISO/IEC 17025 for the General Requirements for the Competence of Calibration and Testing
DOE Quality Systems for Analytical Services (QSAS) Document
DoD Quality Systems Manual for Environmental Laboratories (DoD QSM)
PJLA Accreditation Compliance Requirements

This manual is organized as follows:
ó
Name, Title, Authorization and Approval
Table of Contents
Mission Statement
Statement of Compliance and Matrix Comparison
Introduction and Description
Organization and Responsibility
Quality Assurance Objectives
Personnel Qualification and Training
Instructions and Procedures
Procurement Document Control
Material Receipt and Control
Material Storage and Control
Control of Process
Preventative Maintenance
Control of Measurement and Test Equipment
Data Reduction, Verification, and Reporting
Document Control
Internal Quality Control
Audits
Quality Assurance and Inspection Records
Corrective Action
Quality Assurance Reports to Management

MATRIX COMPARISON

NQA-1, Cross Reference to - Oak Ridge Laboratory Q.A. Program Manual

NQA-1- Quality Assurance Requirements for Nuclear Facility Applications (*Basic Requirements*)		**Oak Ridge, TN laboratory Quality Assurance Program Manual**	
BASIC RQMT	TITLE	QAM SECT	TITLE
1.	Organization	2.0	Organization and Responsibility
2.	Quality Assurance Program	3.0 4.0	Quality Assurance Objectives Personnel Indoctrination and Training
3.	Design Control	N/A	Does not apply
4.	Procurement Document Control	6.0	Procurement Document Control
5.	Instructions, Procedures, and Drawings	5.0	Instructions and Procedures
6.	Document Control	13.0	Document Control
7.	Control of Purchased Items and Services	7.0	Material Receipt and Control
8.	Identification and Control of Items	8.0	Material Storage and Control
9.	Control of Process	9.0	Control of Process
10.	Inspection	14.0	Internal Quality Control
11.	Test Control	14.0	Internal Quality Control
12.	Control of Measurement and Test Equipment	11.0	Control of Measurement and Test Equipment
13.	Handling, Storage, and Shipping	8.0	Material Storage and Control
14.	Inspection, Test, and Operating Status	14.0	Internal Quality Control
15.	Control of Nonconforming Items	8.0	Material Storage and Control
16.	Corrective Actions	17.0	Corrective Actions
17.	Quality Assurance Records	16.0	Quality Assurance and Inspection Records
18.	Audits	15.0	Audits
	N/A	N/A	Title Page
	N/A	N/A	Authorization and Approval Statement
	N/A	1.0	Introduction and Description
	N/A	10.0	Preventive Maintenance
	N/A	12.0	Data Reduction, Verification, and Reporting
	N/A	18.0	Quality Assurance Reports to Management

MATRIX COMPARISON

10 CFR Part 50, Appendix B Cross Reference to Oak Ridge Laboratory Q.A. Program Manual

NRC 10 CFR Part 50 Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants."		**Oak Ridge, TN Laboratory Quality Assurance Program Manual**	
Criterion No.	TITLE	QAM SECT	TITLE
I	Organization	2.0	Organization and Responsibility
II	Quality Assurance Program	3.0	Quality Assurance Objectives
III	Design Control	N/A	Does not apply
IV	Procurement Document Control	6.0	Procurement Document Control
V	Instructions Procedures, and Drawings	5.0	Instructions and Procedures
VI	Document Control	13.0	Document Control
VII	Control of Purchased Material, Equipment, and Deliverables	7.0	Material Receipt and Control
VIII	Identification and Control of Materials, Parts, and Components	8.0	Material Storage and Control
IX	Control of Special Process	9.0	Control of Process
X	Inspections	14.0	Internal Quality Control
XI	Test Control	14.0	Internal Quality Control
XII	Control of Measuring and Test Equipment	11.0	Control of Measurement and Test Equipment
XIII	Handling, Storage, and Shipping	8.0	Material Storage and Control
XIV	Inspection, Tests, and Operating Status	14,0	Internal Quality Control
XV	Nonconforming Materials, Parts or Components	7.0	Material Receipt and Control
XVI	Corrective Actions	17.0	Corrective Actions
XVII	Quality Assurance Records	16.0	Quality Assurance Inspection Records
XVIII	Audits	15.0	Audits
		N/A	Title Page
		1.0	Introduction and Description
		10.0	Preventative Maintenance
		12.0	Data Reduction, Verification, and Reporting
		18.0	Quality Assurance Reports to Management

MATRIX COMPARISON

DOE Order 414.1**C** Cross Reference to Oak Ridge Laboratory Q.A. Program Manual

DOE Order 414.1 C "Quality Assurance"			**Oak Ridge, TN Laboratory Quality Assurance Program Manual**
Criterion No.	TITLE	QAM SECT	TITLE
1.	Program	1.0 2.0 3.0 12.0 13.0	Introduction Organization and Responsibility Quality Assurance Objectives Data Reduction, Verification, and Reporting Document Control
2.	Personnel Training and Qualification	4.0	Personnel Indoctrination and Training
3.	Quality Improvement	17.0	Corrective Actions
4.	Documents and Records	16.0 18.0	Quality Assurance Records Quality Assurance Reports to Management
5.	Work Process	5.0 9.0 10.0 14.0	Instructions and Procedures Control of Process Preventive Maintenance Internal Quality Control
6.	Design	N/A	Does not apply
7.	Procurement	6.0 7.0 8.0	Procurement Document Control Material Receipt and Control Material Storage and Control
8.	Inspection and Acceptance Testing	11.0 14.0 15.0	Control of Measurement and Test Equipment Internal Quality Control Audits
9.	Management Assessment	2.0	Organization and Responsibility
10.	Independent Assessment	15.0	Audits
N/A		N/A	Title Page
N/A		N/A	Authorization and Approval Statement

MATRIX COMPARISON

DOE Quality Systems (QSAS). And DoD Quality Systems (QSM) Cross Reference to Oak Ridge Laboratory QA Program Manual.

This cross reference applies also to NELAC Chapter 5.4.2.3

NELAC Chapter 5 "Quality Systemsċ		**Oak Ridge, TN Laboratory Quality Assurance Program Manual**	
4.2.6 RQMT	TITLE	QAM SECT	TITLE
	Title Page		Title Page
(a)	Policy statement, objectives, commitment by top management	1.0 3.0	Introduction and Description Quality Assurance Objectives
(b)	Organization and Management structure, Org Charts	2.0	Organization and Responsibility
(c)	Relationship between management, technical operations, support services and the quality system	2.0	Organization and Responsibility
(d)	Document control and records retention	16.0	Quality Assurance & Inspection Records
(e)	Job Descriptions	4.0	Personnel Indoctrination and Training
(f)	Approval signatories, signed concurrences	A&A	Authorization and Approval Statement
(g)	Traceability of measurements	14.0	Internal Quality Control
(h)	List of test methods	9.0	Control of Process
(i)	Review for facility and resource availability	9.0	Control of Process
(j)	Calibration or verification test procedures	5.0	Instructions and Procedures
(k)	Procedures for handling submitted samples	9.0	Control of Process
(l)	Major equipment and measurement standards	9.0 11.0	Control of Process Control of Measurement & Test Equipment
(m)	Calibration, verification, & maintenance	11.0	Control of Measurement & Test Equipment
(n)	Inter laboratory comparison, proficiency testing, reference material, internal Q.C.	14.0	Internal Quality Control
(o)	Corrective actions	17.0	Corrective Actions
(p)	Departures from policy/procedures	5.0	Instructions and Procedures
(q)	Complaints	1.0	Introduction and Description
(r)	Confidentiality and Proprietary rights	1.0	Introduction and Description
(s)	Audits and Data reviews	12.0 15.0	Data Reduction, Verification, and Reporting Audits
(t)	Personnel experience and training	4.0	Personnel Indoctrination and Training
(u)	Ethical and legal responsibilities	1.0	Introduction and Description
(v)	Analytical results reporting	12.0	Data Reduction, Verification, and Reporting
(w)	Table of Contents	TOC	Table of Contents

MATRIX COMPARISON

10 CFR Part 830.122 Cross Reference to Oak Ridge Laboratory Q.A. Program Manual

10CFR 830.122 "Quality Assurance Criteria"			**Oak Ridge, TN Laboratory Quality Assurance Program Manual**
Criterion No.	TITLE	QAM SECT	TITLE
830.122 (a)	Management/Program	1.0 2.0	Introduction Organization and Responsibility
(b)	Management/Personnel Training and Qualification	4.0	Personnel Indoctrination and Training
(c)	Management/Quality Improvement	3.0 14.0 17.0	Quality Assurance Objectives Internal Quality Control Corrective Actions
(d)	Management/Documents and Records	5.0 9.0 12.0 13.0 16.0 18.0	Instructions and Procedures Control of Process Data Reduction, Verification, and Reporting Document Control Quality Assurance Records Quality Assurance Reports to Management
(e)	Performance/Work Process	7.0 8.0 10.0 14.0	Material Receipt and Control Material Storage and Control Preventive Maintenance Internal Quality Control
(f)	Performance/Design	N/A	Does not apply
(g)	Performance/Procurement	6.0	Procurement Document Control
(h)	Performance/Inspection and Acceptance Testing	11.0 14.0 15.0	Control of Measurement and Test Equipment Internal Quality Control Audits
(i)	Assessment/Management Assessment	2.0	Organization and Responsibility
(j)	Assessment/Independent Assessment	2.0 15.0	Organization and Responsibility Audits
N/A		N/A	Title Page
N/A		N/A	Authorization and Approval Statement

MATRIX COMPARISON

EPA SW-846 Cross Reference to - Oak Ridge Laboratory Q.A. Program Manual

EPA SW-846 (Essential Elements)		**Oak Ridge, TN Laboratory Quality Assurance Program Manual**	
BASIC RQMT	TITLE	QAM SECT	TITLE
1.	Title Page	N/A	Title Page
2.	Table of Contents	N/A	Table of Contents
3.	Project Description	1.0	Introduction and Description
4.	Project Organization and Responsibility	2.0	Organization and Responsibility
5.	Q.A. Objectives	3.0	Quality Assurance Objectives
6.	Sampling Procedures	N/A	Does not apply to laboratory
7.	Sample Custody	9.0	Control of Process
8.	Calibration Procedures and Frequency	11.0	Control of Measurement and Test Equipment
9.	Analytical Procedures	5.0 9.0	Instructions and Procedures Control of Process
10.	Data Reduction, Validation, and Reporting	12.0	Data Reduction, Verification, and Reporting
11.	Internal Quality Control Checks	14.0	Internal Quality Control
12.	Performance and System Audits	15.0	Audits
13.	Preventive Maintenance	10.0	Preventive Maintenance
14.	Specific Routine Procedures Used to Assess Data Precision, Accuracy, and Completion	14.0	Internal Quality Control
15.	Corrective Action	17.0	Corrective Actions
16.	Quality Assurance Reports to Management	18.0	Quality Assurance Reports to Management
N/A		N/A	Authorization and Approval Statement
N/A		4.0	Personnel Indoctrination and Training
N/A		6.0	Procurement Document Control
N/A		7.0	Material Receipt and Control
N/A		8.0	Material Storage and Control
N/A		13.0	Document Control
N/A		16.0	Quality Assurance and Inspection Records

MATRIX COMPARISON

EPA QA/R-5 ñEPA Requirements for Quality Assurance Project Plansò

EPA QA/R-5, "EPA Requirements for Quality Assurance Project Plans"		Oak Ridge, TN Laboratory Quality Assurance Program Manual	
RQMT	**TITLE**	**SECT**	**TITLE**
A	**Project Management**		
A1	Title and Approval Sheet		Title Page Authorization and Approval (A&A) Statement
A2	Table of Contents		Table of Contents Page Headers (document control)
A3	Distribution List		Title Page
A4	Project/Task Organization	1.4 2.1 2.2 2.5	Introduction Organizational Structure Responsibility Organization Charts
A5	Problem Definition/Background	3.0 9.0 14.0	Quality Assurance Objectives Control of Process Internal Quality Control
A6	Project/Task Description	9.0	Control of Process
A7	Quality Objectives and Criteria	3.0	Quality Assurance Objectives
A8	Special Training/Certification	4.0	Personnel Indoctrination and Training
A9	Documents and Records	5.0 9.2 13.0 16.0	Instructions and Procedures Documented Procedures Document Control Quality Assurance and Inspection Records
B	**Data Generation and Acquisition**		
B1	Sampling Process Design (Experimental Design)	N/A	
B2	Sampling Methods	N/A	
B3	Sample Handling and Custody	14.4	Sample Custody
B4	Analytical Methods	5.0 9.0	Instructions and Procedures Control of Process
B5	Quality Control	14.0	Internal Quality Control
B6	Instrument/Equipment Testing, Inspection, and Maintenance	10.0 11.0	Preventive Maintenance Control of Measurement and Test Equipment
B7	Instrument/Equipment Calibration and Frequency	11.0	Control of Measurement and Test Equipment
B8	Inspection/Acceptance of Supplies and Consumables	7.0 8.0	Material Receipt and Control Material Storage and Control
B9	Non-direct Measurements	10.0	Data Reduction, Verification, and Reporting
B10	Data Management	10.0	Data Reduction, Verification, and Reporting
C	**Assessment and Oversight**		
C1	Assessments and Response Actions	15.0 17.0	Audits Corrective Action
C2	Reports to Management	18.0	Quality Assurance Reports to Management
D	**Data Validation and Usability**		
	Data Review, Verification, and Validation	12.0	Data Reduction, Verification, and Reporting

EPA QA/R-5, "EPA Requirements for Quality Assurance Project Plans"		Oak Ridge, TN Laboratory Quality Assurance Program Manual	
RQMT	**TITLE**	**SECT**	**TITLE**
D1		14.3	Data Verification
D2	Verification and Validation Methods	12.0	Data Reduction, Verification, and Reporting
D3	Reconciliation with User Requirements	12.0	Data Reduction, Verification, and Reporting

1.0 INTRODUCTION AND DESCRIPTION

1.1 PREFACE

Eberline Services ï Oak Ridge Laboratory is a radiochemistry laboratory that specializes in providing services for radiological assays to the environmental industry. Radionuclides are quantified within materials such as surface water, ground water, drinking water, wastewater, soil, sediment, sludge, vegetation, and hazardous waste. Bioassay (urine) analysis is performed for total uranium. The objective of the laboratory is to produce the highest quality data that are accurate, precise, legally defensible, and meet our clients data needs and requirements in a timely and cost effective manner.

The management of Eberline Services, Oak Ridge Laboratory is committed to a rigorous Quality Assurance (Q.A.) Program. While this commitment is necessary for the normal conduct of business, our basic policies dictate the highest standards of ethics and integrity in the conduct of our affairs. This philosophy and the specific procedures to attain policy objectives fromthe framework of our Q.A. Program. We will provide only those services that are within our qualifications and with confidence that our Q.A. Program and all related operating procedures dictate reliable performance of those services.

1.2 PURPOSE

This manual outlines management's Q.A. policy and establishes a requirement that procedures be promulgated and implemented to accomplish all of the quality assurance elements necessary to fulfill our responsibility to meet or exceed client or regulatory specifications. It also provides a means for creating mutual understanding regarding our Q.A. program and reliability techniques with our subcontractors, suppliers, and clients. This Eberline Services-Oak Ridge Laboratory Quality Assurance Program provides the structure, policies and responsibilities for the execution of quality control and quality assessment operations to assure that the laboratory meets defined standards of quality.

1.3 SCOPE

This Quality Assurance Program Manual provides guidance to meet operational Q.A. requirements.

In addition to the documents identified in the Cross Reference Section, this Manual complies with applicable requirements of the following the latest revisions of regulations below:

1.3.1 NRC 10 CFR Part 21, "Reporting of Defects and Non-compliance."

1.3.2 ANSI/ANS-10.3-, "Documentation of Computer Software.

1.3.3 NRC Regulatory Guide 4.15, Rev. 1, "Quality Assurance for Radiological Monitoring Programs - Effluent Streams and the Environment."

1.3.4 U.S. EPA QA/R-5, "EPA Requirements for Quality Assurance Program Plans."

1.3.5 DOE Order 414.1C ñQuality Assurance.ò

1.3.6 ISO/IEC 17025, "General Requirements for the Competence of Calibration and Testing Laboratories."

1.3.7 USEPA Directive 2185, ñGood Automated Laboratory Practicesò(GALP).

1.3.8 DOE Quality Systems for Analytical Services (QSAS)

1.3.9 DoD Quality Systems Manual for Environmental Laboratories (DoD QSM)

1.3.10 A National Environmental Laboratory Accreditation Conference (NELAC) Chapter 5 ñQuality Systemsò, July 2003.

1.3.11 USEPA Manual for the Certification of Laboratories Analyzing Drinking Water, EPA 815-R-004, January 2005.

1.4 INTRODUCTION

Quality assurance, as outlined herein, is a tool that allows management to utilize the expertise and experience of all personnel on the job. It requires each worker to be aware of his/her work environment and to continually evaluate methods and processes to ensure that the best and correct operation is being performed. It requests each employee to identify and suggest any improvement to the processes while performing an operation. Improvements or changes shall be coordinated with management who will validate improvement and disseminate the information to all affected personnel. Management shall also, as needed, change procedures and provide additional training. This program also requires that all personnel be qualified, and trained on a continuing basis to maintain that qualification and be assimilated into the Oak Ridge Laboratory quality culture.

Management will provide resources, tools, equipment, scheduling, and training to ensure personnel can perform their duties effectively.

1.4.1 Management will also ensure that internal assessments are performed annually to evaluate management and processes with feedback for review with a goal of improving all areas of operations.

1.4.2 It is only by having a quality assurance culture, with all personnel involved, that a system, service, or product can be provided with full assurance that the best possible work, the best possible product, or the best possible service has been provided.

1.4.3 In order to ensure that this manual is an effective management tool, subjects that are not normally considered quality assurance, i.e. safety, security, etc., are addressed in other management documents.

1.4.4 The following titled designations of positions are used within the Oak Ridge, TN Laboratory:

Laboratory Manager: Refers to the General Manager of the Oak Ridge Laboratory.

Radiation Safety Officer (RSO): Refers to the RSO of the Oak Ridge Laboratory.

Emergency Coordinator: Refers to the individual who is responsible for overseeing and directing activities and protocols associated with emergencies and disasters..

Project Manager: Refers to an individual who is responsible for client service activities and is the single point of contact with a client for the laboratory.

Supervisor: Refers to individuals within the laboratory who are responsible for the operational functions of a group of personnel.

Q.A. Manager: Refers to the individual who is responsible for the Laboratoryôs Q.A.

Program.

1.5 DESCRIPTION

This document outlines the organization of the Q.A. functions within the laboratory. It depicts the lines of authority, and lists the duties and responsibilities within the organization. It provides direction for the preparation of Procedures Manuals, which provide the detailed methods of processes and analyses that accomplish the goal of quality data in terms of precision, accuracy and reproducibility.

1.6 CONFIDENTIAL AND PROPRIETARY INFORMATION

Oak Ridge Laboratory employees are exposed to confidential and/or proprietary information pertaining to the company and its clients. Information concerning the report of analysis, radiation dosimetry records, audit reports, calibration reports, and other documents relating to a project are considered confidential. This information is to be released only to the client or to the client's authorized representative. Each employee will sign an agreement with the Oak Ridge, TN Laboratory concerning the security of proprietary and confidential information. A copy of the agreement will be retained in the employee's personnel file (at the corporate office in Albuquerque, NM).

1.7 TECHNICAL COMPLAINTS

Technical complaints will be addressed by the Laboratory Manager, Project Manager, Quality Assurance Manager, or staff member with expertise in the area of complaint. If the complaint is not valid, every attempt will be made to satisfy the client. If the complaint is determined to be valid, the cause of the complaint shall be identified and corrected as soon as feasible. Verification that the cause for a valid complaint has been corrected is the responsibility of the individual addressing the complaint. Details of all technical complaints shall be recorded and maintained in the customer's project file. Clients are also encouraged to provide feedback on the Eberline Analytical website via a statement on each client report.

1.8 ETHICAL AND LEGAL RESPONSIBILITIES

Eberline Services-Oak Ridge Laboratory utilizes a clearly stated ethics policy that is discussed with all new employees during orientation. Each employee is required to understand the high standards of ethics and integrity required in order to perform their duties and to ensure the integrity of the data reported in connection with their employment at the Oak Ridge Laboratory. Each employee will understand that intentionally reporting data that are not the actual values obtained, intentionally reporting dates and/or times or data analyses that are not the actual dates and/or times of analyses, intentionally representing another individuals work as their own; or any other action that may affect the integrity of the data reported by the laboratory; will be the cause for dismissal.

1.9 ACCREDITATIONS

Through applications, pre-qualification, performance testing, and external auditing programs; the laboratory has been granted certification by different agencies, organizations, and states. The Laboratory maintains proficiency as required by the clients and regulatory certifying agency. The Quality Assurance Manager maintains credentials and lists of certifying agencies. The list of certifications maintained by the Oak Ridge Laboratory includes:

State of Tennessee, Department of Health ï Laboratory Division
State of California, Department of Public Health ï ELAP Branch
State of South Carolina, Dept of Health & Environmental Control, Environmental Lab Certification Program

State of Utah, Department of Health Bureau of Laboratory Improvement
State of New Jersey, Department of Environmental Protection, Office of Quality Assurance
State of New York, Department of Health, Environmental Lab Approval Program
State of North Dakota, Dept. of Health Environ. Lab. Certification Program - Chemistry Division
State of Nevada, Dept. of Conservation Bureau of water Quality Environmental Lab Services
State of Louisiana, Department of Environmental Quality
State of Texas, Texas Commission of Environmental Quality
State of Alabama, Department of Environmental Management
Commonwealth of Virginia, Dept. of General Services Division of Consolidated Lab Services
State of Washington, Department of Ecology**Perry Johnson Laboratory Accreditation, Inc.**
Department of Energy (DOE)
Department of Defense (DoD)

2.0 ORGANIZATION AND RESPONSIBILITY

2.1 ORGANIZATIONAL STRUCTURE

The Laboratory Manager has overall responsibility for this Quality Assurance Program (hereafter referred to as the Program). In this capacity, he has delegated the responsibility for formulation, implementation, and execution of the Program to the Laboratory Q.A. Manager.

Current organizational charts, identifying key individuals and the structure of the laboratory, are included in the "Statement of Qualifications." Additional organizational structure, functional responsibilities, levels of authority, and lines of communication for management, direction, and execution of the Program are documented below.

2.2 RESPONSIBILITY

Laboratory Management will periodically assess the integrated quality assurance program, its performance, and its effectiveness. Problems that hinder the organization from achieving its objectives will be identified and corrected.

Management will provide training and qualification to ensure quality products and services. Every employee is responsible for supporting the QA program policies, procedures, and guidance with each employee being responsible for their work. Professional qualifications and experience of all individuals and positions are maintained. Position descriptions and resumes are kept on file in the QA office. The specific duties of selected personnel are described below. Other job descriptions are located within an employeeôs training file in the QA office.

2.2.1 Laboratory Manager

The Laboratory Manager, under the authority of the President of Eberline Analytical Corporation, is responsible for the overall laboratory productivity and optimization of the efforts of the analytical staff and those who directly support the analytical effort. Staff interacts with the Lab Manager throughout the day. The Laboratory Manager is responsible for the implementation of regulatory standards, and national program requirements (NELAP, TNI, DOE, and DoD). The Laboratory Manager is responsible for the all safety aspects of the laboratory operations.

The duties of the Laboratory Manager include the following.

- Overall direction and general administration.
- Daily operation of the laboratory.
- Review of analytical procedures and practices.
- Recruitment, hiring, assignment, evaluation and termination of personnel.
- Training and professional development of staff.
- Review of proposals, bids, pricing and quotations.
- Perform an annual assessment of the laboratory operation.

2.2.2 Quality Assurance Manager

The Quality Assurance Manager operates independently from line management while reporting to the Laboratory Manager. The QA Manager has sufficient authority and organizational freedom to identify quality problems, to initiate, recommend or provide solutions; to verify implementation of solutions, and if necessary, to stop work until the problem is resolved. The QA Manager has independence from cost scheduling, and production considerations. In his capacity, he has the authority to control processing, delivery, installation, or use of items or services until proper disposition of an identified non-conformance, deficiency, or condition adverse to quality. The QA

Manager has a direct line of communication to the President of Eberline Analytical Corporation for matters of quality.

The duties and responsibilities of the QA Manager are as follows.

- Develop QA procedures, instructions and plans.
- Maintain surveillance over all applications of the QA Program; make recommendations for resolution of problems, or further evaluation by management.
- Monitor external audits, write responses, and ensure corrective actions.
- Issue non-conformances and formal corrective action(s).
- Issue stop-work orders for work that is not in compliance with requirements.
- Direct, and maintain records of analytical performance evaluation programs to ensure full and prompt participation and evaluation of results and derivation of all benefits relating there from.
- Direct, and maintain records of laboratory certification programs.
- Authorized to sign and designate other personnel to sign client related Certificates of conformance and/or non-conformance.
- Ensures compliance with Regulatory Standards and National Program requirements (e.g. NELAP, TNI, DOE, DoD, . . .)

2.2.3 Health and Safety Manager

The Health and Safety Manager reports directly to the Laboratory Manager and oversees the daily implementation of the laboratory's health and safety program. The program includes an integrated chemical hygiene plan, safety orientation and training, radiation safety plans and training, sample disposal and shipment, and safety checks and audits.

- The duties and responsibilities of the Health and Safety Manager are as follows.
- Administer chemical hygiene, safety, fire extinguisher, etc. training.
- Management of sample disposal in conformance with the waste disposal policy.
- Packaging and shipment of samples, or designation thereof, following DOT regulations.
- Maintain Material Safety Data Sheet (MSDS) documentation.
- Direct spill response.
- Direct safety checks and audits.
- Ensures compliance with regulatory standards and national program requirements (NELAP, TNI, DoD, DOE, . . .)

2.2.4 Technical Director

The Technical Director reports directly to the Laboratory Manager and provides technical direction or advice for the laboratory operations and/or special programs, projects, or activities.

- The duties and responsibilities of the Technical Director are as follows.
- Perform technical analysis for specific projects.
- Make recommendations for research and development.
- Write technical manuals.
- Design systems, procedures, and documentation as necessary.
- Assist chemistry supervisors and technicians in technical interpretation of program requirements.
- Consult with clients, make recommendations regarding analytical schemes.

2.2.5 Data Review Department Staff

The Data Review Department has been structured to handle the specific project requirements of

our clients. The Department is responsible for producing quality control (QC) reports, for ensuring proper assembly of data packages and production of electronic data deliverables (EDDs) that meet the requests of the clients. Data Review personnel, in concert with the QA Manager, will assess the requirements of the various programs and client specific requirements, then interact with the appropriate laboratory personnel to ensure compliance with the clientôs statement of work. These efforts improve the accuracy and efficiency with which QC reports and data packages are prepared and forwarded to the client. Data deliverables are those items associated with the analyses of samples that are provided to the client.

Data Review staff responsibilities include the following.

- Assuring that analytical data have been correctly entered in the final report.
- Assuring that data are not released without reviews.
- Assuring that all data are released to the correct contact person.
- Producing QC reports.
- Assembling Data Packages.
- Ensuring that submitted EDD are complete, verified and in appropriate format.

2.3 ASSESSMENT

2.3.1 The Laboratory Manager will perform routine and continuous assessment of the management system to identify, correct, and prevent management problems that hinder achievement of the organizationôs objective. The assessment will focus on broad categories of management issues to determine the effectiveness of the integrated management system.

2.3.2 Laboratory Managerôs assessments will not be conducted to verify conformance to regulations, product standards, or established procedures, but will evaluate customer and employee perceptions relative to the following key issues.

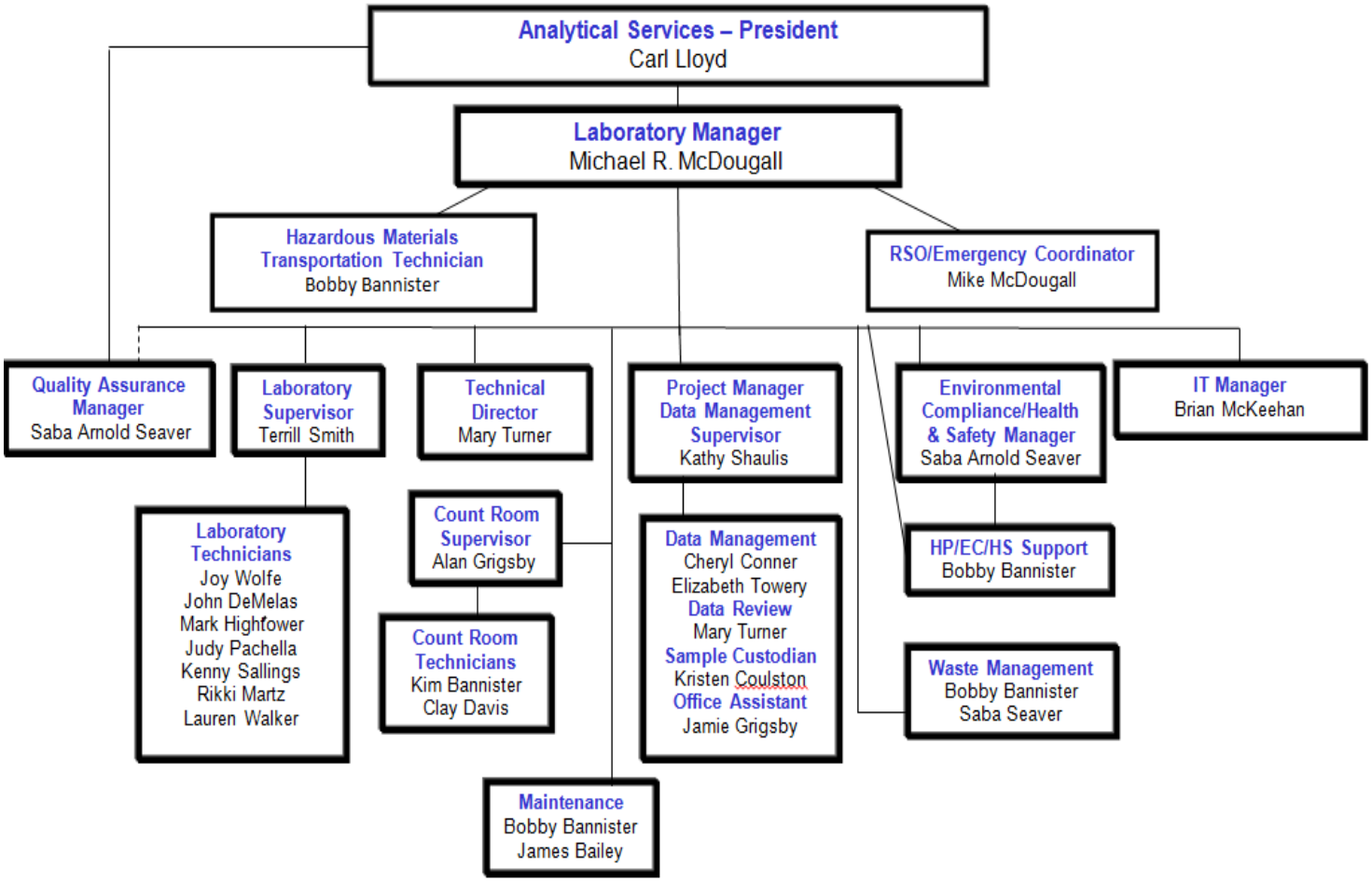
- Mission and strategic objectives of the organization.
- Employeesôrole in the organization.
- Customersôexpectations and degree to which expectations are being met.
- Opportunities for improving quality and cost effectiveness.
- Recognizing and enhancing human resource capabilities.

2.3.3 Results of the Laboratory Managerôs management assessment and recommendations will be documented annually. Decisions and related actions resulting from the recommendations will be properly followed up and evaluated for their effectiveness. Moreover, the opportunity for customer feedback is afforded by means of an on-line customer feedback/satisfaction survey on the laboratory website.

2.4 ORGANIZATION CHARTS

2.4.1 The Oak Ridge Laboratory Organization is illustrated in Figure 2.1

Figure 2.1
Oak Ridge, TN Laboratory Organization



3.0 QUALITY ASSURANCE OBJECTIVES

3.1 OBJECTIVES

The Oak Ridge Laboratory Q.A. Program is organized to meet the following objectives.

3.1.1 To ensure performance of those actions that provide confidence that quality is achieved.

3.1.2 To provide an effective control for the verification of characteristics of all systems, services, and processes that produce data of the required quality.

3.1.3 To ensure that systems, services, processes, and deliverables meet the rigid quality and reliability standards of the Oak Ridge Laboratory. Also, to ensure that individual client criteria pursuant to these standards are met.

3.1.4 To provide a continuing monitoring service for review of operating procedures, and for overall effectiveness and evaluation of the Q.A. Program. Also, to provide observations and recommendations for improvement in all areas of laboratory operations where quality may be affected.

3.1.5 To ensure the program provides valid records of the control measures applied to all factors bearing on the result of investigations.

3.1.6 To ensure the assessment of results provides feedback to improve the process.

3.1.7 To foster a culture of commitment to achieve a rising standard of quality that demands that the methods utilized to achieve the quality systems, services, processes, and deliverables be continuously monitored and improved.

3.2 QUALITY IMPROVEMENT

Operational processes will be reviewed continually by management and employees to detect and prevent problems and to ensure quality improvement. Any item or process that does not meet established requirements will be identified, controlled, and corrected. The cause of problems will be identified with corrections made to prevent recurrence. Item reliability, process implementation, and quality-related information will be reviewed and the data analyzed to identify items and processes needing improvement.

3.3 RESPONSIBILITIES

Employees are an integral part of the organization and are responsible to be aware of their work environment, to review operational processes and materials utilized, to identify any problems, and to make suggestions and recommendations for improvement. Employees are empowered to make and/or recommend corrections to improve operations and to prevent recurrence of the problems. Employees are also empowered, through their supervisor, to stop work where detrimental ethical, contractual, quality, safety, or health conditions exist. Management will immediately be made aware of any situations requiring work stoppage.

All employees are responsible for supporting the Program in principle and in detail and shall retain responsibility for the quality of their work.

Management is responsible to be actively involved in the quality improvement process to ensure

proper focus is maintained and for resolution of difficult issues. Management will maintain a ño faultò attitude to encourage employees to identify problems that compromise safety and reliability. Management will consider all recommendations for quality improvement and will recognize employee contributions.

3.4 CORRECTIONS

Items and processes that do not meet established requirements must be identified, documented, analyzed, and resolved. Corrective actions will be implemented and followed up to ensure effectiveness.

No laboratory analytical data will be revised or corrected after reporting to clients without full documentation of the process. The documentation must show: a) what necessitated the change; b) details of the change in terms of re-run records or recalculation; c) approval process for the change; d) formal client notification.

4.0 PERSONNEL QUALIFICATION AND TRAINING

4.1 QUALIFIED PERSONNEL

4.1.1 The Oak Ridge Laboratory personnel who perform activities that affect quality will have education, experience and training to ensure that suitable proficiency is achieved and maintained. A job description, identifying position qualification and duty requirements, will be included in each individual's training records.

4.1.2 All personnel will have training outlining their ethical and legal responsibilities, including the potential punishment and penalties for improper, unethical, or illegal actions.

4.1.3 Personnel performing technical functions or processes will have known and documented related work experience and minimum qualifications of education.

4.2 RESPONSIBILITY

4.2.1 Supervisors are responsible for initial evaluation of capabilities and qualifications of assigned personnel and will assign those personnel to perform functions based on the individual's qualifications and abilities.

4.2.2 Supervisors and managers are responsible for the day-to-day monitoring of assigned personnel for evidence of unethical, improper, or illegal activities.

4.2.3 Appropriate training is the responsibility of the supervisors with support from management. Training will address specific needs and will vary according to each job's requirements and previous experience of the employee, and will ensure:

4.2.3.1 Understanding of the fundamentals of the work and its context,

4.2.3.2 Understanding of the processes and tools being used, the extent and sources of variability in those processes and tools, and the degree to which control over the variability is maintained,

4.2.3.3 Emphasis on correct performance of the work, understanding why quality requirements exist, and potential consequences of improper work, and

4.2.3.4 Emphasis on "doing it right the first time.ò A particular emphasis is placed on employee safety.

4.2.4 Management will provide ALL employees the resources, tools, equipment, scheduling, and structured training to ensure personnel can perform their duties effectively. New employees will receive detailed information concerning the general corporate policies and the specific laboratory safety practices, and security policies. Training shall be conducted on an individual basis to achieve and maintain suitable proficiencies. The training will include, but will not be limited to:

- Ethical and Legal responsibilities
- Health and Safety
- Radiation Protection
- Waste Management
- Quality Assurance
- Laboratory Procedures
- LIMS Operation

4.2.5 Access to all laboratory documents and procedures will be available at all times to all employees who will be expected to familiarize themselves with these documents.

4.2.6 Milestone achievements or unique training will be noted by the supervisors via entry in the training records. Available certificates of training, education, or awards will also be maintained with the individual's training records.

4.2.7 Supervisors will monitor individual work habits to ensure proficiency is maintained, to note progressive improvement, and to identify any needed supportive training. Additional training requirements will be developed by the individual's supervisor.

4.2.8 As needed, employees will be informed of the requirements of special clients/programs necessary to achieve their duties and responsibilities. Familiarization will be made a matter of record.

4.2.9 All personnel training records will be maintained in the QA office. The details for maintenance of training requirements and records are outlined in the Oak Ridge Laboratory Management Procedure, MP-042 ñPersonnel Training."

5.0 INSTRUCTIONS AND PROCEDURES

5.1 POLICY

The Oak Ridge Laboratory policy uses written and approved procedures for routine activities and for analytical and operational processes. Applicable Laboratory procedures are available to all personnel. The most current revision of the appropriate procedure will be maintained and documented on the laboratory computer server. Departures from routine procedures due to non-standard situations or specific requests from clients will be approved by management and fully documented.

In addition to analytical procedures (AP) the laboratory maintains Management Procedures (MP) that describe the policy and approach for performing quality functions. Separate procedures for Health and Safety, Radiation Protection and Waste Management, are also maintained.

5.1.1 ANALYTICAL PROCEDURES

Analytical procedures are descriptions of particular protocols for testing or operations. Analytical procedures will be developed based on published reference procedures for each test or process, and authorized for use by the Laboratory Manager.

5.1.2 Qualification requirements for personnel performing operations and criteria used to determine the proficiency of the operator will be documented.

5.1.3 Each technical procedure will include a list of Personal Protective Equipment (PPE) required for the operation being performed. Training for the identification, operation, use, limitations, and disposal of the PPE will be conducted.

5.1.4 Each technical procedure will identify any chemicals/reagents required for completion of the operation. Material Safety Data Sheets (MSDSs) for those chemicals/reagents will be readily available, and training applicable to the MSDSs will be conducted.

5.1.5 Training will be conducted to the procedures used for processing wastes generated within the appropriate chemistry laboratory.

5.2 PROCEDURE MANUALS

Procedure manuals consist of the individual analytical procedures for a laboratory area or for an operation combined into one document. The procedures within the manual define all parameters of the operations being performed to include required accuracy and completeness of specific measurement parameters involved. Procedures will be incorporated into procedure manuals. Signature on the Authorization and Approval page applies to all procedures in the manual.

5.3 FORMAT AND DISTRIBUTION

5.3.1 Procedures will comply with the format prescribed in the laboratory management procedure (MP-021, Preparation of Technical and Project QA Documents) and will be approved by the QA Manager and the Laboratory Manager.

5.3.2 Employee access to the most current revision of procedures and manuals will be through the Laboratory computer server. Any distribution of controlled copies of any Laboratory procedure will be in accordance with the laboratoryôs document control protocol.

5.3.3 The Laboratory Manager is responsible for the maintenance and security of the original electronic version of all laboratory procedures and manuals and for ensuring that the most current revision of the procedures and manuals are promptly posted and accessible to all employees.

5.4 REVIEW

Laboratory technical procedure, manuals and Quality Assurance Plan will be reviewed annually and whenever program or procedural changes occur with updates as appropriate. Such reviews will be documented. All effected laboratory personnel and document holders will be made aware of any changes. Training of laboratory personnel on new changes will be conducted as necessary.

5.5 REVISION

5.5.1 The appropriate supervisor, or designated representative, is responsible for revisions or changes to the applicable procedure manuals.

5.5.2 Revisions are reviewed and approved by the organization(s) and personnel responsible for the original document. When possible, revisions or changes will be accomplished on a page replacement basis.

5.5.3 The Q.A. Manager will be advised of any changes in procedures required to satisfy specifications of the client.

5.5.4 The final revision shall be reviewed, approved, and authorized by the laboratory manager and QA manager. The electronic copy is placed on the laboratory server for access.

5.5.5 The Q.A. Manager will be responsible for the electronic retention of past revised and superseded procedures. The Q.A. Manager will also be responsible for maintaining the server location where current revisions are stored for employee reference.

6.0 PROCUREMENT DOCUMENT CONTROL

6.1 PURCHASING

Procurement of material, components, supplies, reagents, equipment, and services necessary to carry on the business interests of the Oak Ridge Laboratory is initiated by purchase requisition and controlled by the use of an authorized purchase order number. To the extent necessary, purchase orders will require suppliers to have a Q.A. program consistent with the requirements of this document. Detailed information on procurement is outlined in the laboratoryôs Purchasing Procedure.

6.2 PURCHASE REQUISITION REVIEW

Purchase requisitions or change orders are reviewed by purchasing department personnel to ensure conformance to the procurement requirements. As applicable, quality related requisitions are reviewed by Q.A. personnel prior to being processed. Change orders undergo the same review process.

6.3 CERTIFICATION/CERTIFICATE OF CONFORMANCE

All materials and processes requiring certification and certificates of conformance are identified on the face of the purchase requisition. Adequate information is provided to ensure supplier compliance to the required specifications. The Q.A. Manager is responsible for the retention, filing, and recall of material certification or certificates of conformance.

6.4 SUBCONTRACTS

When subcontracting analytical work, Oak Ridge Laboratory Management will ensure that the subcontractor can meet all the technical specification, maintain the appropriate certification (NELAP, DOE, DoD, State, . .) and that the prospective subcontractor has a QA program consistent with the requirements of this document. The Oak Ridge Management will secure the client approval for subcontracting their analytical work prior to commencement of the subcontract. The Q.A. Manager is responsible for evaluation and acceptance of the subcontractor's Q.A. program.

6.5 VENDORS

6.5.1 For procurement of quality-related items or services, the Q.A. Manager is responsible for vendor evaluation and approval. Analytical service vendor evaluation and qualification will be through accreditation as a secondary standard calibration laboratory (NVLAP, NIST); an audit by Oak Ridge Laboratory personnel or an acceptable audit agency; or facility inspection, test reports, or receipt inspections, when the quality of the materials or service can be verified by these methods. Documentary evidence that products and services conform to procurement requirements will be provided and retained. A list of approved vendors will be maintained by the Procurement Office.

6.5.2 The effectiveness of the control of quality by contractors and subcontractors will be assessed at intervals consistent with the importance, complexity, and quantity of the product or services.

6.5.3 The purchasing department is responsible for maintaining a record of quality related materials received from vendors including any reports for non-conforming material.

6.6 QUALITY RELATED SERVICES

Q.A. personnel will review the purchase requisitions for quality related services. Those services that are determined to be quality related will include, as applicable, a statement, or wording, in the body of the purchase order or by attachment identifying the applicable requirement.

7.0 MATERIAL RECEIPT AND CONTROL

7.1 POLICY

Only material components, supplies, reagents or standards with acceptable quality characteristics and from qualified vendors will be allowed into the laboratory.

7.2 RESPONSIBILITY

Receipt and initial verification of all materials and equipment received by the Oak Ridge Laboratory, either purchased or contract (client) supplied, is the responsibility of the receiving or designated individual. Technical verification for materials and equipment will be performed by the requisitioner or Q.A. Manager, whichever is applicable. Quality related purchase order items will be receipt inspected by Q.A. personnel.

7.3 MATERIAL CONTROL

Purchased material is controlled by the Laboratory Supervisor or designated individual.

7.3.1 The receiving and stock control clerk, or designated individual, is responsible for the expedient and correct routing of all initially accepted received materials to stock, or to the requisitioner.

7.3.2 Purchasing department personnel are responsible for maintaining a record of materials received from vendors, including Rejected Material Report or equivalent form, for any non-conforming material.

7.4 NON-CONFORMING MATERIAL

When received material, affecting quality, has been determined to be non-conforming, the requisitioner will work with the purchasing agent and will be responsible for proper processing.

7.5 RECORDS

Records of receipt of services and supplies that affect the quality of laboratory operation will be identified with date of receipt, expiration date, source, lot or serial identifier, and calibration or certification records as appropriate.

8.0 MATERIAL STORAGE AND CONTROL

8.1 POLICY

All materials and supplies in storage will have the necessary protection to preclude deterioration, corrosion, or damage during storage life and will carry identification sufficiently clear to ensure that only those materials specified by process instructions will be withdrawn from material storage and issued for processing.

Only analytical grade chemicals and reagents, bearing such grade identification will be utilized by the Laboratory. Each container will be assigned a unique identification number upon receipt. The date of receipt will be posted on each container. The use and the retention (shelf life) of such chemical will be monitored by the Laboratory Supervisor.

All standards used by the Laboratory must be NIST certified. Each standard must be accompanied with a certificate showing the name, composition, concentration, reference number and NIST Certification. The use and distribution of these standards will be monitored by the LIMS. The certificate and certification documents of standards will be controlled by the QA department.

8.2 RESPONSIBILITY

Only authorized personnel will have access to, and the responsibility for, control and issue of materials or supplies. Materials and supplies will be stored to allow for ready identification. Care will be taken to preclude mixing of rejected material and supplies with those that are qualified for issue.

9.0 CONTROL OF PROCESS

9.1 STANDARD PRACTICES

Standard practices applicable to services provided by the Oak Ridge Laboratory are contained in documented procedures and this Q.A. Program Manual. Every effort is made to implement and fulfill the requirements of Federal and local laws, rules, guidance(s), and directives as may be applicable to the operational practices within the Oak Ridge Laboratory. These may include but are not limited to:

9.1.1 Federal and State rules and regulations.

9.1.2 Consensus standards related to the services performed (e.g., American National Standards Institute).

9.1.3 Regulatory Guides published by the Nuclear Regulatory Commission, Department of Energy, the Environmental Protection Agency, and the Department of Defense.

9.1.4 Specific contractual agreements with clients.

9.1.5 Where conflicts may occur among any of the above items, the client will be notified and requested to specify the practice to be followed.

9.2 DOCUMENTED PROCEDURES

Routine analytical operating procedures are documented. Each laboratory procedure includes quality control criteria that are applicable to that process. The laboratory management will develop, promulgate, and implement procedures that document the operations performed in the laboratory. Additionally, the following general procedures or documents, as applicable, will be developed:

9.2.1 Quality Assurance Procedures

9.2.2 Radiation Safety Manual and Procedures

9.2.3 Sample Control Procedures

9.2.4 Purchasing Policies and Procedures

9.2.5 Data Review Procedures

9.2.6 Environmental Compliance Procedures

9.2.7 Safety Procedures

9.2.8 Chemical Hygiene Plan

9.2.9 Hazard Communications Program

9.2.10 LIMS Procedures

9.2.11 Management Procedures

9.2.12 Analytical Procedures

9.3 RESPONSIBILITY

The Laboratory Manager, or designated representative, determines which instructions or procedures require quantitative or qualitative acceptance criteria and specify the appropriate criteria on special contracts or projects.

9.4 WORK POLICY

All work to be performed by the Oak Ridge Laboratory on client samples is authorized by the client and controlled through a Laboratory Information Management System (LIMS) work order document which incorporates the client's requirements. (Or by some other document deemed necessary by the Laboratory Manager or Project Manager as directed by the customer)

9.4.1 The work order specifies those analyses necessary to assure compliance with contractual obligations.

9.4.2 The Project Manager or designated personnel ï under the authority of the Laboratory Manager, are responsible for notifying the Q.A. Manager and performing laboratory departments, through the appropriate supervisor, of all contract requirements including reporting format and quality control criteria. This may be done by reference to other documents (e.g., Purchase Order, statement of work, technical specifications, etc.) that delineates the contract requirements.

9.4.3 The Project Manager or designee ï under the authority of the Laboratory Manager-, will ensure planning, scheduling, and resources are considered when contracting for or accepting work.

9.4.4 When subcontracting analytical services, the Project Manager or designated individual under the authority of the Laboratory manager-, will assure that:

- The client is notified in writing of the intention to subcontract any portion of the testing to another party.
- If the work is covered under NELAP, the work will be placed with a laboratory accredited under NELAP for the tests to be performed.
- Records, demonstrating that the above requirements have been met, are retained in the project folder.

10.0 PREVENTIVE MAINTENANCE

10.1 POLICY

Preventive maintenance is performed as required on instrumentation and equipment to prevent down time and to ensure reliable performance. The laboratories maintain instrument redundancy that precludes the requirement for a repair and maintenance capability for instrumentation. Maintenance and/or repair of equipment are performed by the equipment manufacturer or authorized representative under contract or purchase order.

10.2 MAINTENANCE

Preventive maintenance procedures will be developed for use where instructions are not provided in the manufacturer supplied operator's manual. As applicable, each department will maintain a major equipment and measurement standards list. A record of instrument maintenance, calibration, and repair, if applicable, will also be maintained. The supervisors and operating personnel are responsible for complying with the department maintenance schedule.

10.3 SPARE PARTS

Supervisors will ensure that an adequate inventory of spare parts and consumables is requisitioned and maintained for instrumentation in their area in order to prevent down time or compromise operating conditions.

11.0 CONTROL OF MEASUREMENT AND TEST EQUIPMENT

11.1 MEASUREMENT AND TEST EQUIPMENT CALIBRATION POLICY

This section establishes the controls and calibration requirements for all analytical and nuclear measurement equipment. An equipment list will be maintained indicating calibration status.

11.1.1 All equipment whose operation and function directly affect the quality of service will be inspected/calibrated at established intervals. As applicable, equipment will be suitably identified to reflect calibration status. If an instrument is determined to be out-of-tolerance, it will be segregated, or otherwise clearly identified as inoperable. Records of each calibration will be kept in appropriate logbooks or files. Instruments whose calibrations are performed during method operations are calibrated and controlled in accordance with the method requirements. Run logs will be maintained for this category of instrumentation.

11.1.2 The equipment used to determine the quality characteristics and accuracy of instruments will be checked and verified either internally (dependent upon capability), or by qualified calibration services.

11.1.3 Frequency of inspection/calibration will be based on use of the equipment or instrument, environmental conditions in which it is used, its inherent stability, manufacturer's recommendation, and the wear or deterioration resulting from its use.

11.1.4 Certified standards are used for all primary calibrations. National Institute of Standards and Technology (NIST) or NIST traceable, Environmental Protection Agency (EPA), New Brunswick Laboratory (NBL), or Department of Energy (DOE) standards are used, when available, for the primary calibrations or verification of primary calibrations.

11.1.5 All preparations of standard solutions are recorded in a standards preparation logbook or file. Identities of standards are such that a secondary standard or dilution can be traced, through subsequent actions, back to the initial certification. Records of these reference standards are organized in a secure location in the QA office.

11.1.6 Quality control check standards are used to record instrument sensitivity and linearity and to verify proper response. Methods and calibration entries are dated, initialed, and documented by the analyst.

11.1.7 Measuring and test equipment are tagged as to calibration or operating status for periodic processes performed on a scheduled interval of greater than one month. For processes performed more frequently, separate documentation will be available for verification of operational status. Instruments that are too small to be tagged or are subject to a wide variety of calibrations shall have separate documentation of status available.

11.2 RESPONSIBILITY

Testing and/or calibration of equipment and instruments will be performed under the direction of the supervisor, the department manager, or the operations manager and performed under suitable environmental conditions.

11.3 PROCEDURES

All tests and calibrations will be performed in accordance with written procedures that contain provisions for ensuring that all prerequisites for the given test have been met, including appropriate equipment to be used.

11.4 CERTIFICATION AND CERTIFICATES OF CALIBRATION

11.4.1 To the extent possible, calibration will be traceable to NIST. Records of traceability will be maintained along with records of routine calibrations of each instrument or measurement system. Where no NIST traceability exists, the basis used for calibration will be documented.

11.4.2 Equipment records will be maintained to indicate past and current status, and to provide reproducibility and traceability of results.

11.5 RADIOACTIVE SOURCE CALIBRATION

Radioactive sources used as calibration standards will be periodically calibrated and controlled. Current calibration certificates will be kept on file.

11.6 CALIBRATION RECORDS

Supervisors will ensure that calibration data for instruments and radioactive sources is recorded in the instrument logbook, on data work sheets, on computer files and/or control charts. When required, new calibration charts will be prepared when there is measurable change in calibration effect on instruments that have been calibrated. If an instrument is determined to be out of tolerance, it will be segregated or otherwise clearly tagged as inoperable and not used until repaired.

11.7 REPORTS GENERATED FROM USE OF A DEFICIENT INSTRUMENT

If a major deficiency in an instrument or device is detected during periodic calibration procedures, the technician will immediately notify the supervisor, the operations manager, and the Q.A. Manager. A conference will immediately be scheduled to investigate and decide what corrective action is to be taken on past data and reports resulting from the use of the deficient instrument or device. A record of corrective actions will be maintained.

11.8 PERFORMANCE CHECKS OF RADIATION SCREENING INSTRUMENTS

Performance checks will be made to ensure the continuing capability of radiation screening instruments. Procedures will include efficiency checks and background determinations. The procedure and frequency of each check is optimized for each detector system to provide assurance of the detector's performance. Documentation of the checks and the results are kept for all operations.

12.0 DATA REDUCTION, VERIFICATION, AND REPORTING

12.1 USE OF COMPUTER HARDWARE AND SOFTWARE

Computer programs used in the production or support of client data are either purchased, or developed using approved development methodology. Such programs are independently validated, verified, and documented. Changes are controlled to assess the potential impact of the change on the performance of the program.

12.2 DATA REDUCTION AND VERIFICATION

Sample receipt and distribution through the laboratory is documented by the sample receiving technician. Sample handling, subsampling, and preparation for counting measurement are documented by the laboratory technicians.

12.2.1 The successful completion of an analysis is monitored by the Counting Room staff. The Laboratory Manager, or designated individual, performs the final review and approves the data.

12.2.2 Calculation methods, transcriptions, and data flow, plus times and locations of the various tiers of review are detailed in the specific procedure.

12.3 REPORTING

The Project Manager or designated individual is responsible for providing the client with the required analytical results. Reports to clients will be reviewed for accuracy and completeness and, where required, analytical methods and minimum/method detection limits (MDL) will be reported. Laboratory reports of analyses will be signed by an authorized individual who, along with the person who signed the data sheets, can attest to the fact that the data was generated in accordance with established procedures.

13.0 DOCUMENT CONTROL

13.1 POLICY

The primary formal communication methods within the Oak Ridge Laboratory departments are documents that inform or direct activities affecting purchasing, sample analyses and reporting, instrument calibration and/or testing, radiation controls, proper handling of wastes, radiation safety, and Health and Safety. These documents are controlled by the Q.A. Program Manual, Operating Procedure Manuals, other documented procedures, or by interoffice memoranda. Drawings and specifications are not controlled as separate documents but are included in controlled procedures where applicable. The QA Office controls logbooks used to document the analysis of samples (see MP-023, Documentation of Analytical Laboratory Notebooks).

13.2 RESPONSIBILITY

13.2.1 The Q.A. Manager is primarily responsible for maintaining files of all controlled documents and will:

- Review the Quality Assurance Program Manual and provide recommendations for updating.
- Ensure that all holders of controlled documents receive updates to the documents.
- Maintain files of controlled document distribution indicating document title, number, revision number, assigned date, and the name of the individual to whom the document is assigned.
- Forward revisions of controlled documents to assigned individuals. An acknowledgment form will accompany each document revision for verification of receipt and to provide disposition instructions for the superseded pages
- Maintain a Master List of current procedures which includes procedure number, procedure title, current revision number, and date on which the current revision became effective. The list will be continually updated to reflect all new revisions or new procedures issued. An electronic copy of this list shall be available for employee reference at all times.

13.2.2 Uncontrolled copies of controlled documents will be distributed only if marked "Uncontrolled."

13.2.3 Superseded and/or obsolete documents are isolated from use or destroyed. Upon training to new revisions, employees sign to verify the destruction of all uncontrolled copies of obsolete revisions.

13.2.4 Each employee is responsible for requesting revisions or changes to operating procedures for their area of responsibility.

13.2.5 The Q.A. Manager will be advised of any changes in procedures required to satisfy client specific requirements.

13.2.6 Client information and records such as contract requirements, project descriptions, analytical data and results submitted to the client; and all laboratory records associated with such submittal will be maintained by the laboratory for a minimum of 5 (Five) years. Clients will be contacted and queried for disposition instructions for their related documentation.

13.2.7 If or when the laboratory may transfer ownership, is decommissioned, or goes out of business, ALL clients will be notified and asked to provide specific direction regarding the transfer or disposition of documents and records related to their project(s).

14.0 INTERNAL QUALITY CONTROL

14.1 LABORATORY ANALYTICAL SERVICES

Precautions are taken in the chemistry laboratories to avoid cross-contamination of samples and to ensure the reporting of accurate results. Quality control samples are analyzed along with routine samples to indicate when results may be in error due to improper operation or calibration of equipment, inadequate training of personnel, a deficiency in the procedure, or cross-contamination from other samples.

14.1.1 Laboratory Precision - Laboratory management personnel are responsible to ensure that analytical results are reproduced internally within acceptable limits.

14.1.2 Precision and Accuracy - Replicate standards and/or samples are used to estimate the precision of each analytical test procedure for a known matrix. Data control limits are established to satisfy the requirements of specific measurements based on prior knowledge of the measurement system and method validation studies. Certified standards and/or spiked samples are used to estimate chemical recovery and accuracy for these procedures for known matrices.

14.1.3 Calibration and Performance Checks of Nuclear Measurement Systems - Reference standards are used for calibrating nuclear measurement systems. In addition to calibration of all instrumentation, routine monitoring is performed to ensure the continuing integrity of the instrument performance. The monitoring parameters performed include efficiency checks, background determinations, and energy calibrations. The procedure and frequency of each check is optimized for each detector system to provide assurance of the detector's performance. Documentation of the checks and the results are kept for all systems. The supervisor is responsible for these calibration and performance checks.

14.1.4 Duplicate Analysis - Duplicate aliquots of randomly selected samples will be processed on a routine basis. The analyst will always process samples in accordance within approved operating procedures. The evaluation of the duplicate analysis will be based on examination of the difference between the duplicates. A statistical analysis of the data may be performed when a cursory evaluation indicates problems with the results. If the two results agree within the three standard deviation limits, a more detailed evaluation will generally not be necessary. Results of duplicate analyses will be included in the monthly Q.C./Q.A. report.

14.1.5 Detection and Elimination of Bias - Where possible, calibration will be with standards that are traceable to NIST. However, traceability to NIST is not always possible and reliance on other suppliers may be necessary (e.g., International Atomic Energy Agency, U.S. Department of Energy, U.S. Environmental Protection Agency, or commercial supplier such as Analytics, Amersham Biosciences, AEA Technology, etc.). Standards in the appropriate geometry or form will be used to determine efficiency of instruments on a periodic basis. In the calibration process, the ideal standard will be a known quantity of the radionuclide to be measured, prepared in exactly the same geometry as the samples and counted under the same conditions. In this way, factors such as self-absorption, backscatter, sample geometry, and detector efficiency will be accounted for empirically.

14.1.6 Spiked Samples - A known quantity of calibrated radioactive standard solution will be added to an aliquot of the sample or to a "blank" sample for replicate analysis. When the entire analytical system is operating properly, the laboratory record will demonstrate the accuracy and precision of the data. Divergent data from the spiked sample will point out

problem areas. If the data is consistently higher or lower than the known value, bias in the analytical procedure is indicated. This may require a search for personnel errors, re-standardization of carriers or tracers, and/or recalibration of counting equipment. .

14.1.7 Background Determination - The type of equipment and environmental factors contribute to variation in the counting rate of instrument background. The background of each system instrument will be determined and recorded with sufficient frequency to provide a firm statistical basis for that measurement and to ensure response to potential instrument problems or other artifacts such as controlled contamination.

14.1.8 These background determinations will include use of the items that most closely duplicate the analytical configuration in type, geometry, and with any associated fixtures. In some cases, true blanks are not available, but the closest practicable analog is used.

14.1.9 Some systems are sufficiently stable to require no change in backgrounds used for data reduction (e.g., uranium daughter gamma-rays found in gamma spectra due to adjacent building materials and earth). In this case, backgrounds will be compared to historical data to insure sufficient stability. Other systems experience enough variability to require computed backgrounds based upon running averages.

14.1.10 Background data will be recorded in the logbook or computer file for that specific instrument along with calibration data and instrument maintenance records.

14.1.11 Blanks - Blank samples are routinely analyzed to verify control of contamination and process. Results of processed blanks will be included in the monthly Q.C./Q.A. report.

14.1.12 Collaborative Testing - The Oak Ridge Laboratory participates in collaborative testing or inter-laboratory comparison programs. Natural or synthetic samples prepared to contain known concentrations of certain radionuclides are sent to participating laboratories by an independent referee group such as the DOE Radiological and Environmental Sciences Laboratory DOE, Idaho Falls, Idaho (MAPEP); by a NELAC approved provider such as the Environmental Resources Agency (ERA), Environmental Measurements Laboratory (EML), or by customer(s).

These programs enable Oak Ridge Laboratory personnel to document the precision and accuracy of radioactivity measurements, identify instrumental and procedural problems, and compare performance with other laboratories.

14.2 QUALITY CONTROL AND DATA REPORTS

14.2.1 Quality Control Reports

Quality control results will be summarized, and include with every sample/group of samples.

14.2.2 Data Reports

Routine performance requires documentation of all pertinent information with the basic documents dated and initialed or signed. Required documentation will be the initial work order, Chain-of-Custody (CoC), or document that records all pertinent information such as the identity of the sample and analyses to be performed. The data report will include technical analysis notes, logbooks, work sheets all raw data and other information used in performing the analysis. The report of analysis will be the final report of the data to the client and is issued in accordance with the laboratory's procedure for review and processing, as well as any client specific requirements.

14.3 DATA VERIFICATION

Routine performance requires inclusion of all pertinent information with basic documents dated and initialed or signed. The work order has recorded such information as the identity of the samples and analyses to be performed. All raw data and other information used in performing the

analyses are documented.

14.3.1 Electronic Deliverables Verification - Project managers, or designated individuals, are responsible for ensuring that electronic deliverables are complete and accurate.

14.4 Sample Custody

Samples are assigned a unique laboratory identification number, marked on a label that is applied directly to the container and which identifies the work order and laboratory fraction. Sample control personnel are designated sample custodians for strict (legally defensible) CoC samples. Locked buildings, refrigerators, freezers, and cabinets are available for CoC samples. Sample custody forms or technician analysis notes are used for tracking all samples through the analytical process. Details for radiological survey of samples, sample security, sample disposal, etc. are outlined in approved Sample Control Procedures. Sample chemistry and nuclear counting requirements are assigned by the laboratory manager, or designated individuals.

15.0 AUDITS

15.1 POLICY

The Oak Ridge Laboratory has established a comprehensive system of planned and documented audits to verify compliance with all aspects of the Q.A. Program. An audit is defined as a documented activity performed in accordance with written procedures or checklists to verify, by examination and evaluation of objective evidence, that applicable elements of the Q.A. Program have been developed and effectively implemented in accordance with specific requirements. Audits will be performed by persons not having direct responsibility for those areas being audited.

15.1.1 Customer Access to the Oak Ridge Laboratory Facilities and Personnel - The client is frequently responsible for auditing the Oak Ridge Laboratory's performance relative to contractual requirements. The exact nature of this responsibility is relative to the nature of the regulatory or licensing requirements, the significance of the services, and the technical expertise available or inherent within the client's organization. The need for, and frequency of, client audits is dependent upon the above factors. A client may authorize an independent agency to perform an audit on its behalf. When possible, the facilities, equipment, and records (proprietary information excluded) of the Oak Ridge Laboratory will be made available for client inspection along with the necessary personnel to permit verification of quality characteristics.

15.1.2 The Q.A. Manager will coordinate and participate in audits conducted by the client or the client's representative.

15.1.3 Internal Audits - The Q.A. Manager will audit the laboratory operations to verify compliance with established procedures and requirements set forth in the Q.A. Program Manual. Use of a checklist will insure items in compliance are noted as well as any requirements for improvement.

15.1.4 External Audits - External audits of organizations providing services to the Analytical Services Group are scheduled at a frequency commensurate with the status and importance of the activity.

15.2 RESPONSIBILITY

Audits will be directed by the Q.A. Manager with assistance from designated personnel.

15.2.1 The Q.A. Manager will be responsible for an independent quality assurance audit of each department.

15.2.2 The Q.A. Manager will be responsible for assuring that audits are performed by knowledgeable professionals.

15.2.3 An independent qualified auditor will audit areas of responsibility assigned to the Q.A. Manager.

15.3 DOCUMENTATION

Audit results will be documented by the Q.A. Manager.

15.3.1 The Laboratory Manager shall be provided a copy of the audit report.

15.3.2 The QA Manager will determine if there are any corrective actions required and the individual responsible for implementing the corrective action

15.4 DEFICIENT AREAS

15.4.1 The responsible Manager will ensure correction of the identified deficiencies.

15.4.2 The Q.A. Manager will verify that action is taken to correct any deficiency and will take follow-up action to ensure that corrections have been completed.

15.4.3 The Q.A. Manager will ensure close out, with documentation, of the audit after corrective actions have been completed.

15.4.4 For uncorrected or unresolved deficiencies, after due diligence, the Q.A. Manager will petition the Laboratory Manager to bring to bear his authority for resolution of the deficiencies.

15.5 FREQUENCY OF AUDITS

The Q.A. Manager will ensure internal audits are conducted on an annual basis. Additional selective audits will be conducted when one or more of the following conditions exist:

15.5.1 When significant changes are made in functional areas of the Q.A. Program, including significant reorganization or procedure revisions.

15.5.2 When assessment of the Program's effectiveness is considered necessary.

16.0 QUALITY ASSURANCE AND INSPECTION RECORDS

16.1 POLICY

Records that provide objective evidence of the quality of work are generated and maintained. These records include controlled logbooks, customer instructions, sample analyses data sheets, and results of reviews, inspections, tests, audits, corrective actions, reports, and training records. Also included are related data such as personnel qualifications, procedures, and equipment records.

16.2 RESPONSIBILITY

The responsibility for initiation, completeness, and reliability of Q.A. records is vested in the appropriate supervisor, with periodic verification checks by the Q.A. Manager. All Oak Ridge Laboratory personnel performing processes or services associated with the work being performed will assist in the efforts.

16.3 RECORDS

16.3.1 Inspection and test records will, at a minimum, identify the inspector or data recorder, the type of observation, the results, the action taken in connection with any deficiencies noted, and the date of the inspection or test.

16.3.2 All required records will be legible and of a quality that can be copied. Records shall be completed using reproducible ink. Errors or incorrect entries will be lined through with a single line, dated, and initialed by the recorder.

16.3.3 Correspondence from clients may be made available for inspection at the discretion of client representatives and authorization from the originating organization.

16.3.4 Q.A. records will be identified and controlled by customer number and/or client identification as applicable.

16.4 STORAGE OF RECORDS

16.4.1 Quality assurance records will be firmly attached in binders, placed in folders or

envelopes, and, if applicable, cross referenced by client identification and stored in a secure area.

16.4.2 Q.A. records will be properly stored and made available to the client upon request.

16.4.3 Records will be maintained in a secured and protective storage area.

16.4.4 Records will be identified and be retrievable.

16.4.5 CoC records are included with the sample set records.

16.4.6 Longer retention or duplication of records is available at the specific direction from the client.

16.4.7 Laboratory management will be responsible for governing access to, and controlling the records.

16.4.8 Analytical reports and source calibration data will be retained for a minimum of five years after results are reported to the client.

16.4.9 Procurement records will be retained for a minimum of five years or as required by the contract.

16.4.10 All records and analyses performed pertaining to (NELAC) accreditation will be kept for a minimum of 5 years and would be available for inspection by the accrediting authorities during this period even without prior notification to the laboratory.

17.0 CORRECTIVE ACTION

17.1 POLICY

The Oak Ridge Laboratory policy is to ensure continuous acceptable quality levels for services provided. Conditions adverse to quality will be identified and corrected as soon as practical.

17.2 CORRECTIONS

17.2.1 CORRECTIVE ACTION REPORT (CAR)

In the case of a significant condition adverse to quality, the cause of the condition shall be determined and corrective action taken to preclude recurrence. The identification, cause, and corrective action shall be documented and reported to appropriate levels of management. Follow-up action shall be taken to verify implementation of this corrective action and documented via a Corrective Action Follow-Up form. The Corrective Action Report (CAR) Form shall be used to document this condition. Typically, the Q.A. Manager will initiate investigation and corrective action by issuing a Corrective Action Report (CAR) in any of the following situations:

- When an audit reveals circumstances that will adversely affect quality (Audit Finding) as determined by the Q.A. Manager.
- When any results of an inter-comparison study are out of control, or for non-participation.
- When procedural or technical problems arise and the Q.A. Manager determines that they will significantly affect quality.

17.3 NON-CONFORMANCE REPORT (NCR)

A non-conformance is a deficiency in a characteristic, procedure, or documentation that renders the quality of an item unacceptable, however, is not considered a significant condition that would require an investigation by use of a CAR. In the laboratory, non-conformances can include physical defects, incorrect or inadequate documentation, and deviations from an established protocol, plan, or documented technical requirement. This condition is documented using a Non-Conformance Report (NCR) Form.

17.4 RESPONSIBILITY

All laboratory personnel are responsible to communicate any evidence of unacceptable quality performance to their supervisor, the responsible manager, and/or the Q.A. Manager.

17.4.1 The responsible manager will ensure investigation of a condition adverse to quality, determine assignable cause, and provide recommendation(s) for corrective action.

17.4.2 The responsible manager will ensure action is initiated to correct the assignable cause of the adverse condition and to determine and initiate the specific corrective action(s) necessary to preclude recurrence.

17.4.3 The Q.A. Manager will review CARs, NCRs, and routine Q.C. reports for evidence of unacceptable quality.

17.4.4 Copies of the completed CARs and NCRs will be kept on file by the Q.A. Manager.

17.5 CLIENT NOTIFICATION

The client will be notified when any Corrective Action is initiated due to evidence of unacceptable quality that is related to their contract.

18.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

18.1 POLICY

The Oak Ridge Laboratory policy is to keep management apprised of all quality assurance problems, actions taken to correct them, and any actions taken to prevent recurrence.

18.2 QUALITY ASSURANCE REPORTS

18.2.1 Quality Assurance Reports are prepared quarterly by the QA Manager and submitted to upper management. The reports shall include discussion of inter-comparison studies, status of corrective actions, and quarterly QA objectives.

18.2.2 The Q.A. Manager will report all general or system audit results, problems, corrective actions, and replies.

Document Revision History

Revision	Effective Date	Changes From Previous Revision
7	8/1/13	• Document Revision History table implemented • Added Emergency Coordinator to title designations of positions in Section 1.4.4 • Updated list of accreditations in section 1.9 to reflect all current certifications • Updated Laboratory Organization Chart • Removed requirement for employees to maintain hard copies of procedures in work area.

PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc. has assessed the Laboratory of:

Eberline Ananlytical – Oak Ridge Laboratory

601 Scarboro Road, Oak Ridge, TN 37830-7371

(Hereinafter called the Organization) and hereby declares that Organization has met the requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the DoD Quality Systems Manual for Environmental Laboratories Version 4.2 10/26/2010 and is accredited is accordance with the:

United States Department of Defense
Environmental Laboratory Accreditation Program
(DoD-ELAP)

This accreditation demonstrates technical competence for the defined scope:

Environmental Testing

(As detailed in the supplement)

Accreditation claims for such testing and/or calibration services shall only be made from addresses referenced within this certificate. This Accreditation is granted subject to the system rules governing the Accreditation referred to above, and the Organization hereby covenants with the Accreditation body's duty to observe and comply with the said rules.

For PJLA:

Initial Accreditation Date:	*Issue Date:*	*Accreditation No.:*	*Certificate No.:*
December 18, 2012	December 18, 2012	70747	L12-194

Tracy Szerszen
President/Operations Manager

Perry Johnson Laboratory
Accreditation, Inc. (PJLA)
755 W. Big Beaver, Suite 1325
Troy, Michigan 48084

The validity of this certificate is maintained through ongoing assessments based on a continuous accreditation cycle. The validity of this certificate should be confirmed through the PJLA website: www.pjlabs.com

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Eberline Analytical – Oak Ridge Laboratory

601 Scarboro Road, Oak Ridge, TN 37830-7371
Michael McDougall Phone: 865-481-0683

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Air/Aqueous	Eberline SOP EiChroM AM-01	Alpha Spectroscopy	Isotopic Curium
Air/Aqueous/Solid	AP-016	Beta GPC	Chlorine-36
Air/Aqueous/Solid	AP-026	Beta LSC	Carbon-14
Air/Aqueous/Solid	ASTM D-5174	KPA	Total Uranium
Air/Aqueous/Solid	Eberline SOP EiChroM Ni-01	Beta LSC	Nickel-63
Air/Aqueous/Solid	Eberline SOP EML Pu-01	Alpha Spectroscopy	Isotopic Plutonium
Air/Aqueous/Solid	Eberline SOP EML Th-01	Alpha Spectroscopy	Isotopic Thorium
Air/Aqueous/Solid	Eberline SOP EPA 903.0	Alpha Spectroscopy	Radium-226
Air/Aqueous/Solid	EiChroM Np-01	Alpha Spectroscopy	Neptunium-237
Air/Aqueous/Solid	EiChroM Sr-01	Beta GPC	Strontium-90
Air/Aqueous/Solid	EiChroM Sr-01	Beta GPC	Total Strontium
Air/Aqueous/Solid	EiChroM Tc-01	Beta LSC	Technetium-99
Air/Solid	Eberline SOP EiChroM AM-01	Alpha Spectroscopy	Americium-241
Air/Solid	Eberline SOP EML Pb-01	Beta GPC	Lead-210
Air/Solid	Eberline SOP EML Po-01	Alpha Spectroscopy	Polonium-210
Air/Solid	Eberline SOP EML U-02	Alpha Spectroscopy	Isotopic Uranium
Air/Solid	Eberline SOP EPA 903.0	Alpha GPC	Total Radium
Air/Solid	Eberline SOP EPA 904.0	Beta GPC	Radium-228
Air/Solid	LANL ER-130	Gamma Spectroscopy	Gamma Emitting Radionuclides
Aqueous	EPA 900.0	Alpha Beta GPC	Gross Alpha & Beta
Aqueous	EPA 901.1	Gamma Spectroscopy	Gamma Emitting Radionuclides
Aqueous	EPA 903.0	Alpha GPC	Total Radium
Aqueous	EPA 904.0	Beta GPC	Radium-228
Aqueous	EPA 906.0	Beta LSC	Tritium
Aqueous	EPA 908.0	Alpha Spectroscopy	Isotopic Uranium
Aqueous/Solid	EiChromM Am-01	Alpha Spectroscopy	Americium-241
Solid	EiChromM Am-01	Alpha Spectroscopy	Isotopic Curium

Perry Johnson Laboratory Accreditation, Inc.

PJLA

October 1, 2012

Mr. Michael McDougall
Eberline Analytical – Oak Ridge Laboratory
601 Scarboro Road
Oak Ridge, TN 37830-7371

Dear Mr. McDougall:

This letter is to confirm that you have successfully completed your accreditation assessment. A certificate has now been granted and posted on our website. As you are aware, PJLA will no longer be issuing expiration dates on our certificates. Your certificate # **L12-194** will remain valid as long as you continue to maintain your annual assessments and reaccreditation assessments as stated in your customer agreement with PJLA. At this time, we have confirmed that your annual assessments will be conducted during the month of **June** each calendar year. This will include an interim surveillance assessment and a full system reassessment to be completed by **June 2014**. Once your reassessment is conducted and approved by our accreditation committee a revised status letter will be provided to you. Please allow PJLA at least 120 days from your assessment due date to issue this letter.

Please feel free to release this letter to any interested parties as confirmation of your certificate validity. Also, please remind them that your certificate is posted on our website at all times. Any changes in regards to your accreditation status will be reflected on our website.

We would like to thank you for your patronage and we look forward to continuously serving your accreditation needs in the future. If we can assist you any further, please feel free to contact us at any time.

Sincerely,

Tracy Szerszen
President/Operations Manager

755 W. Big Beaver Rd. · Suite 1325 · Troy, MI 48084 · Phone: 1-877-369-LABS or 248-519-2603 · Fax: 248-213-0737

State of New Jersey
Department of Environmental Protection

Certifies That

Eberline Services - Oak Ridge

Laboratory Certification ID # TN004

is hereby approved as a

Nationally Accredited Environmental Laboratory

to perform the analyses as indicated on the Annual Certified Parameter List which must accompany this certificate to be valid

having duly met the requirements of the

Regulations Governing The Certification Of Laboratories And Environmental Measurements N.J.A.C. 7:18 et. seq.

and

having been found compliant with the 2009 TNI Standard approved by the

The NELAC Institute

Expiration Date June 30, 2014

Joseph F. Aiello, Manager
Office of Quality Assurance

NJDEP is a NELAP Recognized Accreditation Body

This certificate is to be conspicuously displayed at the laboratory with the annual certified parameter list in a location on the premises visible to the public. Consumers are urged to verify the laboratory's current accreditation status with the State of NJ, NELAP.

New Jersey Department of Environmental Protection
Environmental Laboratory Certification Program

LABORATORY PERSONNEL LIST

Effective as of: 07/01/2013

Laboratory Name: EBERLINE SERVICES - OAK RIDGE Laboratory Number: TN004 Activity ID: NLC130001
601 SCARBORO RD
OAK RIDGE, TN 37830

Position: Lead Tech. Director

Employee	Category/Instrument	Start Date	End Date	Documentation Status	Complete Date	Comments
AHMED HALOUMA		7/1/2005	7/31/2012	Complete/Qualified		
MIKE McDOUGALL		7/31/2012		Complete/Qualified		

Position: QA Officer

Employee	Category/Instrument	Start Date	End Date	Documentation Status	Complete Date	Comments
SABA ARNOLD		7/31/2012		Complete/Qualified		
AHMED HALOUMA		4/16/2002	7/31/2012	Complete/Qualified		

Position: Supervisor/Tech Dir

Employee	Category/Instrument	Start Date	End Date	Documentation Status	Complete Date	Comments
AHMED HALOUMA	SDW07, 08, WPP09 or 10	7/1/2005	7/31/2012	Complete/Qualified		
MARY TURNER	SDW07, 08, WPP09 or 10	7/31/2012		Complete/Qualified		

New Jersey Department of Environmental Protection

National Environmental Laboratory Accreditation Program

ANNUAL CERTIFIED PARAMETER LIST AND CURRENT STATUS

Effective as of 07/01/2013 until 06/30/2014

Laboratory Name: EBERLINE SERVICES - OAK RIDGE Laboratory Number: TN004 Activity ID: NLC130001
601 SCARBORO RD
OAK RIDGE, TN 37830

Category: SDW07 -- Radiochem.: Radioactivity / Radionuclide

Status	Eligible to Report NJ Data	State	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	Yes	UT	SDW07.01000	DW	Proportional or Scintillation	[EPA 900.0]	Gross - alpha-beta
Certified	Yes	UT	SDW07.03100	DW	Gamma Spectrometry	[EPA 901.1]	Gamma emitters
Certified	Yes	UT	SDW07.03900	DW	Radiochemical	[EPA 903.0]	Radium - 226
Certified	Yes	UT	SDW07.04100	DW	Precipitation	[EPA 904.0]	Radium - 228
Certified	Yes	UT	SDW07.05000	DW	Precipitation	[EPA 903.0]	Radium - total
Certified	Yes	UT	SDW07.06000	DW	Total Sr & Strontium 90	[EPA 905.0]	Strontium - 89, 90
Certified	Yes	UT	SDW07.06010	DW	Strontium 90	[EPA 905.0]	Strontium - 90
Certified	Yes	UT	SDW07.07000	DW	Distillation/Liquid Scintillation	[EPA 906.0]	Tritium
Certified	Yes	UT	SDW07.08100	DW	Co-Precipition	[EPA 908.0]	Uranium
Certified	Yes	UT	SDW07.08400	DW	Radiochemical / Alpha Counting	[EPA 907.0]	Uranium
Certified	Yes	UT	SDW07.09000	DW	Radiochemical / Alpha Counting	[EPA 907.0]	Plutonium

Category: WPP09 -- Radiochem.: Radioactivity / Radionuclide

Status	Eligible to Report NJ Data	State	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	Yes	UT	WPP09.01000	NPW	Proportional or Scintillation	[EPA 900.0]	Gross - alpha
Certified	Yes	UT	WPP09.03000	NPW	Proportional Counter	[EPA 900.0]	Gross - beta
Certified	Yes	UT	WPP09.05000	NPW	Precipitation	[EPA 903.0]	Radium - total
Certified	Yes	UT	WPP09.05010	NPW	Proportional	[EPA 903.0]	Radium - 226
Certified	Yes	UT	WPP09.06020	NPW	Co-Precipitation / Beta Counting	[EPA 904.0]	Radium - 228
Certified	Yes	UT	WPP09.07000	NPW	Gamma Spectrometry	[EPA 901.1]	Photon Emitters
Certified	Yes	UT	WPP09.08000	NPW	Precipitation / Beta Counting	[EPA 905.0]	Strontium - 89, 90
Certified	Yes	UT	WPP09.08100	NPW	Precipitation / Beta Counting	[EPA 905.0]	Strontium - 90

Category: SHW09 -- Miscellaneous Parameters

Status	Eligible to Report NJ Data	State	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	Yes	UT	SHW09.60000	NPW, SCM	Proportional Counter	[SW-846 9310]	Gross - alpha-beta
Certified	Yes	UT	SHW09.60100	NPW, SCM	Precipitation	[SW-846 9315]	Alpha Emitting Radium Isotopes

KEY: AE = Air and Emissions, BT = Biological Tissues, DW = Drinking Water, NPW = Non-Potable Water, SCM = Solid and Chemical Materials

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

Office of Quality Assurance
401 East State Street
P.O. Box 420, Mail Code 401-02D
Trenton, New Jersey 08625-0420
Telephone: (609) 292-3950
Facsimile: (609) 777-1774

BOB MARTIN
Commissioner

Dear Laboratory Manager:

A Certificate and an Annual Certified Parameter List (ACPL) that reflects the current status of your facility are enclosed. If there are any discrepancies, please contact your Laboratory Certification Officer to verify information and make arrangements for a new ACPL. Effective with the receipt of this letter, your facility's certification status is valid through June 30, 2014. Both the ACPL and Certificate should be conspicuously displayed at your facility in a location on the premises that is visible to the public.

As always, we are available to discuss any comments or questions. Please do not hesitate to contact your Laboratory Certification Officer or me.

Sincerely,

Joseph F. Aiello, Manager

Enclosure(s)

New Jersey Department of Environmental Protection

National Environmental Laboratory Accreditation Program

ANNUAL CERTIFIED PARAMETER LIST AND CURRENT STATUS

Effective as of 07/01/2013 until 06/30/2014

Laboratory Name: EBERLINE SERVICES - OAK RIDGE Laboratory Number: TN004 Activity ID: NLC130001
601 SCARBORO RD
OAK RIDGE, TN 37830

Category: SHW09 -- Miscellaneous Parameters

Status	Eligible to Report NJ Data	State	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	Yes	UT	SHW09.60110	NPW, SCM	Precipitation	[SW-846 9320]	Radium - 228

Joseph F. Aiello, Manager

KEY: AE = Air and Emissions, BT = Biological Tissues, DW = Drinking Water, NPW = Non-Potable Water, SCM = Solid and Chemical Materials

D H E C
PROMOTE PROTECT PROSPER

Catherine B. Templeton, Director
Promoting and protecting the health of the public and the environment

September 19, 2012

MICHAEL MCDOUGALL
EBERLINE SERVICES OAK RIDGE LAB
601 SCARBORO RD
OAK RIDGE, TENNESSEE 37830

Laboratory I. D. 84013

Dear Michael Mcdougall:

Your amended certificate and associated parameter list(s) are enclosed. These documents now represent the certificate of record for your laboratory. Any certificate(s) and associated parameter list(s) received prior to your receipt of these documents are now null and void and should be destroyed. Please be reminded that all environmental data submitted to the Department is reviewed to ensure that the reporting laboratory possesses the necessary certification. Data reported by laboratories without the proper certification will be addressed by the affected enforcement programs.

If you have any questions, or problems are detected concerning your certificate, please contact this office within ten (10) working days.

Sincerely,

Carol F. Smith, Director
Office of Environmental Laboratory Certification
Bureau of Environmental Services

Enclosures

D H E C

PROMOTE PROTECT PROSPER

South Carolina Department of Health and Environmental Control

Environmental Laboratory Certification Program

In accordance with the provisions of Regulation 61-81, entitled "State Environmental Laboratory Certification Regulations"

EBERLINE SERVICES OAK RIDGE LAB
601 SCARBORO RD
OAK RIDGE, TENNESSEE 37830

is hereby certified to perform analyses as documented on the attached parameter list(s). This certification does not guarantee validity of data generated, but indicates the laboratory's adherence to prescribed methodology, quality control, records keeping, and reporting procedures. This certificate is the property of S.C. DHEC and must be surrendered upon demand. This certificate is non-transferable and is valid only for the parameters and methodology listed on the attached parameter list(s).

Laboratory Director: MICHAEL MCDOUGALL
Certifying Authority: TN
Date of Issue: September 19, 2012
Date of Expiration: December 15, 2014
Certificate Number: 84013001

Director
Office of Environmental Laboratory Certification

CR-010021 2/11

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL
ENVIRONMENTAL LABORATORY CERTIFICATION PROGRAM

EBERLINE SERVICES OAK RIDGE LAB (Laboratory ID 84013)
Laboratory Director: MICHAEL MCDOUGALL
Certifying Authority: TN
Certificate Number: 84013001

Date of Issue: September 19, 2012
Expiration Date: December 15, 2014

SAFE DRINKING WATER ACT

INORGANIC - RADIOLOGICAL

GROSS ALPHA	EPA 900.0 (1980)
GROSS BETA	EPA 900.0 (1980)
RADIUM 226	EPA 903.0 (1980)
RADIUM 228	EPA 904.0 (1980)
STRONTIUM 90	EPA 905.0 (1980)
TRITIUM	EPA 906.0 (1980)

State of Tennessee

Department of Environment & Conservation

Division of Water Supply

Certifies That

Eberline Services Laboratory

Having Met the Requirements of the Regulations for the Certification of Laboratories Analyzing Drinking Water is hereby Approved as a

State Certified Laboratory in Radiochemistry

To perform the Analyses as Indicated on the Certified Parameter List For the Public Water Systems of Tennessee

Laboratory ID Number TN02042 - Effective through December 15, 2014

A. Craig LaFever

A. Craig LaFever

Laboratory Certification Manager

Division of Water Supply

This certification is subject to performance on E.P.A. Performance Evaluation Samples, laboratory inspections and payment of annual fees

Certified Parameters - 2011

TENNESSEE

Eberline Services | TN02042 | EPA # TN01067 | 12/16/2011

Attn: Ahmed Halouma
601 Scarboro Road
Oak Ridge, TN 37830-7371

Parameter	EPA Parameter #	Approved Method	Study Type	Date Complete	PT Provider / WS #
Radiological					
Cesium-134 (Radioactive)	4270	EPA - 901.1	Proficiency Test	5/19/2011	ERA / RAD-85
Cesium-137 (Radioactive)	4276	EPA - 901.1	Proficiency Test	5/19/2011	ERA / RAD-85
Cobalt-60 (Radioactive)	4142	EPA - 901.1	Proficiency Test	5/19/2011	ERA / RAD-85
Gross Alpha	4000	EPA - 900.0	Proficiency Test	5/19/2011	ERA / RAD-85
Gross Beta	4100	EPA - 900.0	Proficiency Test	5/19/2011	ERA / RAD-85
Radium-226	4020	EPA - 903.0	Proficiency Test	5/19/2011	ERA / RAD-85
Radium-228	4030	EPA - 904.0	Proficiency Test	5/19/2011	ERA / RAD-85
Strontium 89 (Radioactive)	4172	EPA - 905.0	Proficiency Test	5/19/2011	ERA / RAD-85
Strontium 90 (Radioactive)	4174	EPA - 905.0	Proficiency Test	5/19/2011	ERA / RAD-85
Tritium (Radioactive)	4102	EPA - 906.0	Proficiency Test	5/19/2011	ERA / RAD-85
Uranium (Natural)	4006	EPA - 908.0	Proficiency Test	5/19/2011	ERA / RAD-85
Uranium (Radioactive)	4400	ASTM - D 5174-02	Proficiency Test	5/19/2011	ERA / RAD-85

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER SUPPLY
6th Floor, L & C TOWER, 401 Church Street
Nashville, Tennessee 37243-1549

December 27, 2011

Mr. Ahmed Halouma, QA Mgr
Eberline Analytical Corporation
601 Scarboro Road
Oak Ridge, TN 37830-7371

Re: Audit Report
Lab # TN02042

Dear Mr. Halouma:

Division of Water Supply personnel visited your laboratory and performed an audit on December 12 and December 13, 2011. We would like to thank you and your staff for your courtesy during the audit.

I. Certification Status

The certification for Radiochemistry analyses shall be valid until December 15, 2015. Continued compliance with the State of Tennessee certification criteria is subject to the USEPA laboratory certification criteria and procedures for quality assurance (*Manual for the Certification of Laboratories Analyzing Drinking Water, Fifth Edition, 2005).*

Eberline Analytical Corporation Laboratory (TN02042) is granted Certification for the Radiochemistry methods and parameters listed on the enclosed Certified parameter list.

II. List of Deviations

No Deviations noted.

III. Remarks

We appreciate the willingness to share detailed explanations of the methodology and quality control. As discussed, please forward us the completed SOPs for Uranium 234 and 238 analysis by alpha spectrometry and the SOPs for Strontium-89 and Strontium-90.

IV. Personnel

Name	Specialty
Michael R. McDougall	Laboratory Manager
Ahmed Halouma	Quality Assurance Manager

If you have any questions please do not hesitate to contact the Laboratory Certification Officers Craig LaFever (615-532-0181) Craig.LaFever@.tn.gov or Prasad Subbanna (865-594-5557) Prasad.Subbanna@tn.gov.

Sincerely,

A. Craig LaFever

A. Craig LaFever
Laboratory Certification Officer
Tennessee Division of Water Supply

cc: file

Enclosure

NELAP - RECOGNIZED

CALIFORNIA STATE

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM BRANCH

CERTIFICATE OF NELAP ACCREDITATION

Is hereby granted to

Eberline Analytical Corporation (EPA# TN01067)

601 Scarboro Road

Oak Ridge, TN 37830

Scope of the Certificate is limited to the
"NELAP Fields of Accreditation"
which accompany this Certificate.

Continued accredited status depends on successful
ongoing participation in the program.

This Certificate is granted in accordance with provisions of
Section 100825, et seq. of the Health and Safety Code.

Certificate No.: **08261CA**

Expiration Date: **7/31/2014**

Effective Date: **8/1/2013**

Richmond, California
subject to forfeiture or revocation

David Mazzera, Ph.D., Assistant Division Chief
Division of Drinking Water and Environmental Management

NELAP RECOGNIZED

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM BRANCH

NELAP Fields of Accreditation

Eberline Analytical Corporation (EPA# TN01067)

601 Scarboro Road
Oak Ridge, TN 37830
Phone: (865) 481-0683

Primary AA: UT TN010672012-2

Certificate No. 08261CA
Renew Date: 7/31/2014

106 - Radiochemistry of Drinking Water			
106.010	001	EPA 900.0	Gross Alpha
106.010	002	EPA 900.0	Gross Beta
106.030	003	EPA 901.1	Gamma Emitters
106.050	001	EPA 903.0	Total Alpha Radium
106.050	002	EPA 903.0	Radium-226
106.060	001	EPA 904.0	Radium-228
106.070	001	EPA 905.0	Strontium-89, 90
106.070	002	EPA 905.0	Strontium-89
106.070	003	EPA 905.0	Strontium-90
106.080	001	EPA 906.0	Tritium
106.090	001	EPA 908.0	Uranium
106.480	001	ASTM D5174-97	Uranium
112 - Radiochemistry of Wastewater			
112.010	001	EPA 900.0	Gross Alpha
112.010	002	EPA 900.0	Gross Beta
112.140	002	EPA 901.1	Gamma
112.160	001	EPA 904.0	Radium-228
112.180	001	EPA 906.0	Tritium
112.190	001	EPA 908.0	Uranium
118 - Radiochemistry of Hazardous Waste			
118.010	001	EPA 9310	Gross Alpha
118.010	002	EPA 9310	Gross Beta
118.020	001	EPA 9315	Radium, Total
118.030	001	EPA 9320	Radium-228

As of 7/9/2013 , this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

BOBBY JINDAL
GOVERNOR

PEGGY M. HATCH
SECRETARY

State of Louisiana

DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL SERVICES

July 1, 2013

LELAP Lab ID # 05005
AI No. 168684
Accreditation Year FY2014
Renewal due FY 2016

Ms. Saba Arnold Seaver
Eberline Services - Oak Ridge Lab
601 Scarboro Rd
Oak Ridge, Tennessee 37830-7371

Re: Scope of Accreditation

Dear Ms. Arnold Seaver:

The Louisiana Department of Environmental Quality's laboratory accreditation program, in accordance with Louisiana Administrative Code, Title 33, Part I, Subpart 3, Laboratory Accreditation, accredits this laboratory for Fiscal Year 2014. This accreditation does not constitute an endorsement of the suitability of the listed methods for any specific purpose. The laboratory is accredited for the method as identified on the application for accreditation; if the method is partially identified on the application for accreditation, the laboratory is accredited for the versions listed on the current application or referenced in the laboratory standard operating procedure.

National Environmental Laboratory Accreditation Program (NELAP) accreditation is granted **only** for those methods/analytes for which "NELAP" is indicated as the type of accreditation. "STATE" is indicated as the type of accreditation for those methods/analytes for which accreditation by the Louisiana Environmental Laboratory Accreditation Program (LELAP) is granted. Accreditation is dependent on the laboratory's successful ongoing compliance with regulations as outlined in the Louisiana Administrative Code, Title 33, Part I, Subpart 3, Laboratory Accreditation, and with the standards adopted by the NELAP Accreditation Council.

The accreditation certificate is the property of the State of Louisiana. Should your accreditation be suspended or revoked, your laboratory must return the certificate of accreditation to the department and delete any electronic copies until your accreditation status is restored.

LAC 33:I.5313.A and/or NELAC 5.5.10.1 require that the laboratory report include all relevant information. Therefore, the certificate number shall be placed in the upper right corner of all laboratory reports. If the test report includes results of any test for which the laboratory is not accredited, the unaccredited results must be clearly identified as such.

We request that you examine the scope of accreditation attachment for accuracy and completeness. If you find that an analyte for which you expected to be accredited is not listed, please examine your records to ensure that:

1. You have met the requirements for successful participation in proficiency test studies as outlined in LAC 33:I.4711 and in the NELAC Standard 2.7.2.

2. In the case of accreditation by recognition, the requested analyte must be listed for the requested method and matrix on both the certificate issued by the Primary Accreditation Body ***and*** on the Louisiana application form.

If after reviewing this information, the scope and/or certificate are inaccurate, please notify us immediately.

If you have any questions, please contact your assigned assessor Dr. Alicia B. Ryan, Environmental Scientist at (225) 219-1352.

Sincerely,

Lourdes Iturralde
Administrator
Notifications and Accreditations Section
OES, Public Participation & Permit Support Services Division

LI:PB:abr

STATE OF LOUISIANA
DEPARTMENT OF ENVIRONMENTAL QUALITY

Is hereby granting a Louisiana Environmental Laboratory Accreditation to

Eberline Services - Oak Ridge Lab
601 Scarboro Rd
Oak Ridge, Tennessee 37830-7371

Agency Interest No. 168684

According to the Louisiana Administrative Code, Title 33, Part I, Subpart 3, LABORATORY ACCREDITATION, the State of Louisiana formally recognizes that this laboratory is technically competent to perform the environmental analyses listed on the scope of accreditation detailed in the attachment.

The laboratory agrees to perform all analyses listed on this scope of accreditation according to the Part I, Subpart 3 requirements and acknowledges that continued accreditation is dependent on successful ongoing compliance with the applicable requirements of Part I. Please contact the Department of Environmental Quality, Louisiana Environmental Laboratory Accreditation Program (LELAP) to verify the laboratory's scope of accreditation and accreditation status.

Accreditation by the State of Louisiana is not an endorsement or a guarantee of validity of the data generated by the laboratory. To be accredited initially and maintain accreditation, the laboratory agrees to participate in two single-blind, single-concentration PT studies, where available, per year for each field of testing for which it seeks accreditation or maintains accreditation as required in LAC 33:I.4711.

Lourdes Iturralde, Administrator
Notifications and Accreditations Section
Public Participation & Permit Support Services Division

Certificate Number: 05005

Expiration Date: June 30, 2014
Issued On: July 1, 2013

STATE OF LOUISIANA
DEPARTMENT OF ENVIRONMENTAL QUALITY
Issue Date: July 1, 2013

Eberline Services - Oak Ridge Lab
AI Number: 168684
Expiration Date: June 30, 2014

601 Scarboro Rd, Oak Ridge, Tennessee 37830-7371

Certificate Number: 05005

Air Emissions

Analyte	Method Name	Method Code	Type	AB
NONE	NONE	NONE	NONE	NONE

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
2830 - Gross-alpha	EPA 900	10112400	NELAP	UT
2840 - Gross-beta	EPA 900	10112400	NELAP	UT
2826 - Gamma Emitters	EPA 901.1	10112808	NELAP	UT
1128 - Radium-223	EPA 903	10113209	NELAP	UT
2960 - Radium-224	EPA 903	10113209	NELAP	UT
2965 - Radium-226	EPA 903	10113209	NELAP	UT
2750 - Total alpha radium	EPA 903	10113209	NELAP	UT
2970 - Radium-228	EPA 904	10113607	NELAP	UT
2995 - Strontium-89	EPA 905	10113801	NELAP	UT
3010 - Strontium-89, 90	EPA 905	10113801	NELAP	UT
3005 - Strontium-90	EPA 905	10113801	NELAP	UT
3030 - Tritium	EPA 906	10114008	NELAP	UT
3035 - Uranium	EPA 908	10114202	NELAP	UT
2830 - Gross-alpha	EPA 9310	10208205	NELAP	UT
2840 - Gross-beta	EPA 9310	10208205	NELAP	UT
100210 - Alpha Emitting Radium Isotopes	EPA 9315	10208409	NELAP	UT
2970 - Radium-228	EPA 9320	10208603	NELAP	UT

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
2830 - Gross-alpha	EPA 9310	10208205	NELAP	UT
2840 - Gross-beta	EPA 9310	10208205	NELAP	UT
100210 - Alpha Emitting Radium Isotopes	EPA 9315	10208409	NELAP	UT
2970 - Radium-228	EPA 9320	10208603	NELAP	UT

Biological Tissue

Analyte	Method Name	Method Code	Type	AB
NONE	NONE	NONE	NONE	NONE

NEW YORK
state department of
HEALTH

Nirav R. Shah, M.D., M.P.H.
Commissioner

Sue Kelly
Executive Deputy Commissioner

LAB ID: 11798

April 01, 2013

MS. MARY L. TURNER
EBERLINE SERVICES-OAK RIDGE LAB
601 SCARBORO ROAD
OAK RIDGE, TN 37830

Certificate Expiration Date:
April 01, 2014

Dear Ms. Turner,

Enclosed are Certificate(s) of Approval issued to your environmental laboratory for the current permit year. The Certificate(s) supersede(s) any previously issued one(s) and is(are) in effect through the expiration date listed. Please carefully examine the Certificate(s) to insure that the categories, subcategories, analytes, and methods for which your laboratory is approved are correct. In addition, verify that your laboratory's name, address, lead technical director, and identification number are accurate.

Pursuant to NYCRR Subpart 55-2.2, original certificates must be posted conspicuously in the laboratory and copies shall be made available to any client of the laboratory upon request.

Pursuant to NYCRR Subpart 55-2.6, any misrepresentation of the Fields of Accreditation (Matrix - Method - Analyte) for which your laboratory is approved may result in denial, suspension, or revocation of your certification. Any use of the Environmental Laboratory Approval Program (ELAP) or National Environmental Laboratory Accreditation Program (NELAP) name, reference to the laboratory's approval status, and/or using the NELAP logo in any catalogs, advertising, business solicitations, proposals, quotations, laboratory analytical reports, or other materials must include the laboratory's ELAP identification number and distinguish between testing for which the laboratory is approved and testing for which the laboratory is not approved.

If you have any questions, please contact ELAP at the New York State Department of Health (NYS DOH), Wadsworth Center, PO Box 509, Albany NY, 12201-0509; by phone at (518) 485-5570; by facsimile at (518) 485-5568; and by email at elap@health.state.ny.us.

Sincerely,

Stephanie E. Ostrowski

STEPHANIE OSTROWSKI, PH.D.
Program Director
Environmental Laboratory Approval Program

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. MARY L. TURNER
EBERLINE SERVICES-OAK RIDGE LAB
601 SCARBORO ROAD
OAK RIDGE, TN 37830

NY Lab Id No: 11798

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Drinking Water Metals III	
Uranium (Mass)	ASTM D5174-97 02 07
Radiological Analytes	
Gross Alpha	EPA 900.0
Gross Beta	EPA 900.0
Photon Emitters	EPA 901.1
Radium-226	EPA 903.0
Radium-228	EPA 904.0
Strontium-89	EPA 905.0
Strontium-90	EPA 905.0
Tritium	EPA 906.0
Uranium (Activity)	EPA 908.0

Serial No.: 48873

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. MARY L. TURNER
EBERLINE SERVICES-OAK RIDGE LAB
601 SCARBORO ROAD
OAK RIDGE, TN 37830

NY Lab Id No: 11798

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Radiological Analytes

Gross Alpha	EPA 900.0
Gross Beta	EPA 900.0
Photon Emitters	EPA 901.1
Radium-226	EPA 903.0
Radium-228	EPA 904.0
Strontium-89	EPA 905.0
Strontium-90	EPA 905.0
Tritium	EPA 906.0
Uranium (Activity)	EPA 908.0

Serial No.: 48874

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

Texas Commission on Environmental Quality

NELAP-Recognized Laboratory Accreditation is hereby awarded to

Eberline Services - Oak Ridge Laboratory

601 Scarboro Road
Oak Ridge, TN 37830-7371

in accordance with Texas Water Code Chapter 5, Subchapter R, Title 30 Texas Administrative Code Chapter 25, and the National Environmental Laboratory Accreditation Program.

The laboratory's scope of accreditation includes the fields of accreditation that accompany this certificate. Continued accreditation depends upon successful ongoing participation in the program. The Texas Commission on Environmental Quality urges customers to verify the laboratory's current location(s) and accreditation status for particular methods and analyses (www.tceq.texas.gov/goto/lab). Accreditation does not imply that a product, process, system or person is approved by the Texas Commission on Environmental Quality.

Certificate Number: T104704443-13-5
Effective Date: 10/1/2013
Expiration Date: 9/30/2014

Executive Director Texas Commission on Environmental Quality

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

Certificate: T104704443-13-5
Expiration Date: 9/30/2014
Issue Date: 10/1/2013

Eberline Services - Oak Ridge Laboratory

601 Scarboro Road
Oak Ridge, TN 37830-7371

These fields of accreditation supercede all previous fields. The Texas Commission on Environmental Quality urges customers to verify the laboratory's current accreditation status for particular methods and analyses.

Matrix: ***Drinking Water***

Method EPA 900.0

Analyte	AB	Analyte ID	Method ID
Gross-alpha	UT	2830	10112400
Gross-beta	UT	2840	10112400

Method EPA 901.1

Analyte	AB	Analyte ID	Method ID
Gross gamma	UT	2855	10112808
Radioactive cesium	UT	2955	10112808

Method EPA 903.0

Analyte	AB	Analyte ID	Method ID
Radium-226	UT	2965	10113209

Method EPA 904.0

Analyte	AB	Analyte ID	Method ID
Radium-228	UT	2970	10113607

Method EPA 905.0

Analyte	AB	Analyte ID	Method ID
Strontium-89	UT	2995	10113801
Strontium-90	UT	3005	10113801

Method EPA 906.0

Analyte	AB	Analyte ID	Method ID
Tritium	UT	3030	10114008

Method EPA 908.0

Analyte	AB	Analyte ID	Method ID
Uranium	UT	3035	10114202

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

Certificate:	**T104704443-13-5**
Expiration Date:	**9/30/2014**
Issue Date:	**10/1/2013**

Eberline Services - Oak Ridge Laboratory

601 Scarboro Road
Oak Ridge, TN 37830-7371

These fields of accreditation supercede all previous fields. The Texas Commission on Environmental Quality urges customers to verify the laboratory's current accreditation status for particular methods and analyses.

Matrix: ***Non-Potable Water***

Method EPA 900.0

Analyte	AB	Analyte ID	Method ID
Gross-alpha	UT	2830	10112400
Gross-beta	UT	2840	10112400

Method EPA 903.0

Analyte	AB	Analyte ID	Method ID
Total radium	UT	2975	10113209

Method EPA 908.0

Analyte	AB	Analyte ID	Method ID
Uranium	UT	3035	10114202

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

Certificate:	**T104704443-13-5**
Expiration Date:	**9/30/2014**
Issue Date:	**10/1/2013**

Eberline Services - Oak Ridge Laboratory

601 Scarboro Road
Oak Ridge, TN 37830-7371

These fields of accreditation supercede all previous fields. The Texas Commission on Environmental Quality urges customers to verify the laboratory's current accreditation status for particular methods and analyses.

Matrix: ***Solid & Chemical Materials***

Method EPA 9310

Analyte	AB	Analyte ID	Method ID
Gross-alpha	UT	2830	10208205
Gross-beta	UT	2840	10208205

State of Utah

Department of Health

Environmental Laboratory Certification Program

Certification is hereby granted to

Eberline Services - Oak Ridge Laboratory

601 Scarboro Road
Oak Ridge, TN 37830

Has conformed with the
2009 TNI Standard
Scope of accreditiation is limited to the
State of Utah Accredited Fields of Accreditiation
Which accompanies this Certificate

EPA Number: TN01067
Expiration Date: 9/30/2014
Certificate Number: TN010672013-3

Robyn M. Atkinson, Ph.D, HCLD
Director, Utah Public Health Laboratory

NELAP RECOGNIZED ACCREDITATION BODY

Continued accredited status depends on successful ongoing particitpation in the program.

UTAH DEPARTMENT OF HEALTH

State of Utah
Gary R Herbert
Governor
Gregory S Bell
Lieutenant Governor

Utah Department of Health
W. David Patton Ph.D
Executive Director

Division of Disease Control and Prevention
Robyn M. Atkinson, Ph.D, HCLD
Director, Utah Public Health Laboratory

EPA Number: *TN01067* **Attachment to Certificate Number: TN010672013-3**

Eberline Services - Oak Ridge Laboratory

	Start Date	Expires	AB
Program/Matrix: *CWA (Non Potable Water)*			
Method EPA 900			
Gross-alpha	10/1/2013	9/30/2014	UT
Gross-beta	10/1/2013	9/30/2014	UT
Method EPA 901.1			
Cesium-134	10/1/2013	9/30/2014	UT
Cesium-137	10/1/2013	9/30/2014	UT
Gamma Emitters	10/1/2013	9/30/2014	UT
Method EPA 903			
Radium-223	10/1/2013	9/30/2014	UT
Radium-224	10/1/2013	9/30/2014	UT
Radium-226	10/1/2013	9/30/2014	UT
Method EPA 904			
Radium-228	10/1/2013	9/30/2014	UT
Method EPA 905			
Strontium-89	10/1/2013	9/30/2014	UT
Strontium-89, 90	10/1/2013	9/30/2014	UT
Strontium-90	10/1/2013	9/30/2014	UT
Method EPA 906.0			
Tritium	10/1/2013	9/30/2014	UT
Method EPA 908			
Uranium	10/1/2013	9/30/2014	UT

Eberline Services - Oak Ridge Laboratory

	Start Date	Expires	AB
Program/Matrix: ***RCRA (Non Potable Water)***			
Method EPA 9310			
Gross alpha-beta	10/1/2013	9/30/2014	UT
Method EPA 9315			
Total alpha radium	10/1/2013	9/30/2014	UT
Method EPA 9320			
Radium-228	10/1/2013	9/30/2014	UT

Eberline Services - Oak Ridge Laboratory

	Start Date	Expires	AB
Program/Matrix: ***RCRA (Solid & Hazardous Material)***			
Method EPA 9310			
Gross alpha-beta	10/1/2013	9/30/2014	UT
Method EPA 9315			
Total alpha radium	10/1/2013	9/30/2014	UT
Method EPA 9320			
Radium-228	10/1/2013	9/30/2014	UT

Eberline Services - Oak Ridge Laboratory

	Start Date	Expires	AB
Program/Matrix: ***SDWA (Potable Water)***			
Method ASTM D5174-02			
Uranium	10/1/2013	9/30/2014	UT
Method EPA 00- 02			
Gross-alpha	10/1/2013	9/30/2014	UT
Method EPA 900.0			
Gross-alpha	10/1/2013	9/30/2014	UT
Gross-beta	10/1/2013	9/30/2014	UT
Method EPA 901.1			
Cesium-134	10/1/2013	9/30/2014	UT
Gamma Emitters	10/1/2013	9/30/2014	UT
Iodine-131	10/1/2013	9/30/2014	UT
Method EPA 903			
Radium-223	10/1/2013	9/30/2014	UT
Radium-224	10/1/2013	9/30/2014	UT
Radium-226	10/1/2013	9/30/2014	UT
Total radium	10/1/2013	9/30/2014	UT
Method EPA 904			
Radium-228	10/1/2013	9/30/2014	UT
Method EPA 905			
Strontium	10/1/2013	9/30/2014	UT
Strontium-89	10/1/2013	9/30/2014	UT
Strontium-90	10/1/2013	9/30/2014	UT
Method EPA 906			
Tritium	10/1/2013	9/30/2014	UT
Method EPA 907.0			
Americium-241	10/1/2013	9/30/2014	UT
Curium-242	10/1/2013	9/30/2014	UT
Curium-243	10/1/2013	9/30/2014	UT
Curium-244	10/1/2013	9/30/2014	UT
Neptunium-237	10/1/2013	9/30/2014	UT
Plutonium-238	10/1/2013	9/30/2014	UT
Plutonium-239	10/1/2013	9/30/2014	UT
Plutonium-240	10/1/2013	9/30/2014	UT
Thorium	10/1/2013	9/30/2014	UT
Uranium	10/1/2013	9/30/2014	UT
Method EPA 908			
Uranium	10/1/2013	9/30/2014	UT

The Utah Environmental Laboratory Certification Program (ELCP) encourages clients and data users to verify the most current certification letter for the authorized method.

The analytes by method which a laboratory is authorized to perform at any given time will be those indicated in the most recent certificate letter. The most recent certification letter supersedes all previous certification or authorization letters. It is the certified laboratory's responsibility to review this letter for discrepancies. The certified laboratory must document any discrepancies in this letter and send notice to this bureau within 15 days of receipt. This certificate letter will be recalled in the event your laboratory's certification is revoked.

State of Utah
Gary R Herbert
Governor
Gregory S Bell
Lieutenant Governor

Utah Department of Health
W. David Patton Ph.D
Executive Director

Division of Disease Control and Prevention
Robyn M. Atkinson, Ph.D, HCLD
Director, Utah Public Health Laboratory

EPA Number: ***TN01067*** **Attachment to Certificate Number: TN010672013-3**

Eberline Services - Oak Ridge Laboratory

	Start Date	Expires	AB
Program/Matrix: ***CWA (Non Potable Water)***			
Method EPA 900			
Gross-alpha	10/1/2013	9/30/2014	UT
Gross-beta	10/1/2013	9/30/2014	UT
Method EPA 901.1			
Cesium-134	10/1/2013	9/30/2014	UT
Cesium-137	10/1/2013	9/30/2014	UT
Gamma Emitters	10/1/2013	9/30/2014	UT
Method EPA 903			
Radium-223	10/1/2013	9/30/2014	UT
Radium-224	10/1/2013	9/30/2014	UT
Radium-226	10/1/2013	9/30/2014	UT
Method EPA 904			
Radium-228	10/1/2013	9/30/2014	UT
Method EPA 905			
Strontium-89	10/1/2013	9/30/2014	UT
Strontium-89, 90	10/1/2013	9/30/2014	UT
Strontium-90	10/1/2013	9/30/2014	UT
Method EPA 906.0			
Tritium	10/1/2013	9/30/2014	UT
Method EPA 908			
Uranium	10/1/2013	9/30/2014	UT

Eberline Services - Oak Ridge Laboratory

	Start Date	Expires	AB
Program/Matrix: ***RCRA (Non Potable Water)***			
Method EPA 9310			
Gross alpha-beta	10/1/2013	9/30/2014	UT
Method EPA 9315			
Total alpha radium	10/1/2013	9/30/2014	UT
Method EPA 9320			
Radium-228	10/1/2013	9/30/2014	UT

Eberline Services - Oak Ridge Laboratory

	Start Date	Expires	AB
Program/Matrix: ***RCRA (Solid & Hazardous Material)***			
Method EPA 9310			
Gross alpha-beta	10/1/2013	9/30/2014	UT
Method EPA 9315			
Total alpha radium	10/1/2013	9/30/2014	UT
Method EPA 9320			
Radium-228	10/1/2013	9/30/2014	UT

Eberline Services - Oak Ridge Laboratory

Program/Matrix: ***SDWA (Potable Water)***

	Start Date	Expires	AB
Method ASTM D5174-02			
Uranium	10/1/2013	9/30/2014	UT
Method EPA 00- 02			
Gross-alpha	10/1/2013	9/30/2014	UT
Method EPA 900.0			
Gross-alpha	10/1/2013	9/30/2014	UT
Gross-beta	10/1/2013	9/30/2014	UT
Method EPA 901.1			
Cesium-134	10/1/2013	9/30/2014	UT
Gamma Emitters	10/1/2013	9/30/2014	UT
Iodine-131	10/1/2013	9/30/2014	UT
Method EPA 903			
Radium-223	10/1/2013	9/30/2014	UT
Radium-224	10/1/2013	9/30/2014	UT
Radium-226	10/1/2013	9/30/2014	UT
Total radium	10/1/2013	9/30/2014	UT
Method EPA 904			
Radium-228	10/1/2013	9/30/2014	UT
Method EPA 905			
Strontium	10/1/2013	9/30/2014	UT
Strontium-89	10/1/2013	9/30/2014	UT
Strontium-90	10/1/2013	9/30/2014	UT
Method EPA 906			
Tritium	10/1/2013	9/30/2014	UT
Method EPA 907.0			
Americium-241	10/1/2013	9/30/2014	UT
Curium-242	10/1/2013	9/30/2014	UT
Curium-243	10/1/2013	9/30/2014	UT
Curium-244	10/1/2013	9/30/2014	UT
Neptunium-237	10/1/2013	9/30/2014	UT
Plutonium-238	10/1/2013	9/30/2014	UT
Plutonium-239	10/1/2013	9/30/2014	UT
Plutonium-240	10/1/2013	9/30/2014	UT
Thorium	10/1/2013	9/30/2014	UT
Uranium	10/1/2013	9/30/2014	UT
Method EPA 908			
Uranium	10/1/2013	9/30/2014	UT

The Utah Environmental Laboratory Certification Program (ELCP) encourages clients and data users to verify the most current certification letter for the authorized method.

The analytes by method which a laboratory is authorized to perform at any given time will be those indicated in the most recent certificate letter. The most recent certification letter supersedes all previous certification or authorization letters. It is the certified laboratory s responsibility to review this letter for discrepancies. The certified laboratory must document any discrepancies in this letter and send notice to this bureau within 15 days of receipt. This certificate letter will be recalled in the event your laboratory s certification is revoked.

COMMONWEALTH of VIRGINIA

Department of General Services

Division of Consolidated Laboratory Services

600 North 5th Street
Richmond, Virginia 23219-3691
(804) 648-4480
FAX (804) 692-0416

12/10/2013

Michael R Mcdougall
EBERLINE SERVICES OAK RIDGE LABORATORY
601 Scarboro Road
Oak Ridge TN 37830

VELAP ID: 460218

Dear Michael R Mcdougall:

EBERLINE SERVICES OAK RIDGE LABORATORY has been granted secondary accreditation pursuant to the provisions of 1VAC30-46 and the National Environmental Laboratory Accreditation Program (NELAP) by the Division of Consolidated Laboratory Services (DCLS). Enclosed please find Certificate 2544 and the corresponding Scope of Accreditation which are valid until 12/14/2014. The certificate must be conspicuously displayed in the laboratory along with the associated Scope of Accreditation.

Your laboratory is required to notify the DCLS Virginia Environmental Laboratory Accreditation Program (VELAP) in writing of any changes in key accreditation criteria within 30 calendar days of the change per 1VAC30-46-90 A. This requirement includes changes in ownership, location, key personnel, and major instrumentation.

If your laboratory wishes to change its scope of accreditation an application must be submitted in accordance with the provisions of 1VAC30-46-90 B. These changes are subject to fees as outlined in 1VAC30-46-150 F 1.

Additionally, a laboratory holding secondary accreditation with DCLS is responsible for assuring that DCLS has current information regarding the laboratory's primary accreditation. Upon any change in the status of any field of accreditation, a secondary laboratory must notify DCLS of the exact nature of the change and provide a copy of the laboratory's new primary certificate.

If you have any questions, please contact the VELAP program office at (804)648-4480.

Sincerely yours,

Cathy Westerman
Manager, Virginia Environmental Laboratory Accreditation Program

Enclosures

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF GENERAL SERVICES
DIVISION OF CONSOLIDATED LABORATORY SERVICES

Certifies that

VA Laboratory ID#: 460218
EBERLINE SERVICES OAK RIDGE LABORATORY

601 SCARBORO ROAD
OAK RIDGE, TN 37830

Owner: GLENROSE INSTRUMENT INC, DR. SHELTON CLARK - PRESIDENT
Operator: EBERLINE SERVICES - OAK RIDGE LABORATORY
Responsible Official: MICHAEL R MCDOUGALL

Having met the requirements of 1 VAC 30-46
and the National Environmental Laboratory Accreditation Conference 2003 Standard

is hereby approved as an

Accredited Laboratory

As more fully described in the attached Scope of Accreditation

Effective Date: **December 15, 2013**
Expiration Date: **December 14, 2014**
Certificate # 2544

Thomas L. York, Ph.D., HCLD
DGS Deputy Director for Laboratories

Continued accreditation status depends on successful ongoing participation in the program.
Certificate to be conspicuously displayed at the laboratory.
Not valid unless accompanied by a valid Virginia Environmental Laboratory Accreditation Program (VELAP) Scope of Accreditation.
Customers are urged to verify the laboratory's current accreditation status.

Certificate Not Transferable

Surrender Upon Revocation

Commonwealth of Virginia

Department of General Services
Division of Consolidated Laboratory Services

Scope of Accreditation

VELAP Certificate No.: 2544

EBERLINE SERVICES OAK RIDGE LABORATORY
601 SCARBORO ROAD
OAK RIDGE, TN 37830

Virginia Laboratory ID: 460218
Effective Date: December 15, 2013
Expiration Date: December 14, 2014

DRINKING WATER

METHOD	ANALYTE	PRIMARY
EPA 900.0 1980	GROSS ALPHA	UT
EPA 901.1	CESIUM-134	UT
EPA 903.0	RADIUM-226	UT
EPA 904.0	RADIUM-228	UT
EPA 905.0 1980	STRONTIUM-90	UT
EPA 908.0	URANIUM	UT

METHOD	ANALYTE	PRIMARY
EPA 900.0 1980	GROSS BETA	UT
EPA 901.1	GAMMA EMITTERS	UT
EPA 903.0	TOTAL ALPHA RADIUM	UT
EPA 905.0 1980	STRONTIUM-89	UT
EPA 906.0	TRITIUM	UT

NON-POTABLE WATER

METHOD	ANALYTE	PRIMARY
EPA 900.0 1980	GROSS ALPHA	UT
EPA 901.1	GAMMA EMITTERS	UT
EPA 904.0	RADIUM-228	UT
EPA 905.0 1980	STRONTIUM-90	UT
EPA 908.0	URANIUM	UT
EPA 9310 (9/86)	GROSS BETA	UT
EPA 9320 (9/86)	RADIUM-228	UT

METHOD	ANALYTE	PRIMARY
EPA 900.0 1980	GROSS BETA	UT
EPA 903.0	RADIUM-226	UT
EPA 905.0 1980	STRONTIUM-89	UT
EPA 906.0	TRITIUM	UT
EPA 9310 (9/86)	GROSS ALPHA	UT
EPA 9315 (9/86)	TOTAL ALPHA RADIUM	UT

The State of Washington Department of Ecology

Eberline Services - Oak Ridge Lab
Oak Ridge, TN

has complied with provisions set forth in Chapter 173-50 WAC and is hereby recognized by the Department of Ecology as an ACCREDITED LABORATORY for the analytical parameters listed on the accompanying Scope of Accreditation. This certificate is effective June 15, 2013 and shall expire June 14, 2014.

Witnessed under my hand on June 20, 2013

Alan D. Rue
Lab Accreditation Unit Supervisor

Laboratory ID
C887

WASHINGTON STATE DEPARTMENT OF ECOLOGY

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

SCOPE OF ACCREDITATION

Eberline Services - Oak Ridge Lab

Oak Ridge, TN

is accredited for the analytes listed below using the methods indicated. Full accreditation is granted unless stated otherwise in a note. Accreditation for U.S. Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (SW-846) is for the latest version of the method. SM refers to EPA approved editions of “Standard Methods for the Examination of Water and Wastewater.” ASTM is the American Society for Testing and Materials. Other references are described in notes.

Matrix/Analyte	Method	Notes
Drinking Water		
Gross Alpha	EPA 900.0-80	1
Gross Beta	EPA 900.0-80	1
Gamma Emitters	EPA 901.1-80	1
Radium-226	EPA 903.0-80	1
Radium-228	EPA 904.0-80	1
Strontium-90	EPA 905.0-80	1
Tritium	EPA 906.0-80	1
Total Uranium	EPA 908.0-80	1
Non-Potable Water		
Gross Alpha	EPA 900.0-80	1
Gross Beta	EPA 900.0-80	1
Gamma Emitters	EPA 901.1-80	1
Radium-226	EPA 903.0-80	1
Radium-228	EPA 904.0-80	1
Strontium-90	EPA 905.0-80	1
Tritium	EPA 906.0-80	1
Total Uranium	EPA 908.0-80	1
Solid and Chemical Materials		
Gross Alpha	EPA 9310_(9/86)	1
Gross Beta	EPA 9310_(9/86)	1
Radium-226	EPA 9315_(9/86)	1

Matrix/Analyte	Method	Notes
Radium-228	EPA 9320_(9/86)	1

Accredited Parameter Note Detail

(1) Accreditation based in part on recognition of Utah NELAP accreditation.

06/20/2013

Authentication Signature
Alan D. Rue, Lab Accreditation Unit Supervisor

Date

The Alabama Department of Environmental Management

certifies that

Eberline Services Laboratory

Having met Department laboratory certification criteria, is approved to conduct Drinking Water analyses for the following:

Radionuclides

Effective January 1, 2014 through December 31, 2014

Dennis D. Harrison

Alabama Department of Environmental Management

Laboratory Number **41620**

QA/QC RECEIVED
DATE 1/21/14

Eberline Services Laboratory
Expires December 31, 2014

Analyte	Method
Gross Alpha	900.0
Gross Beta	900.0
Radium-226	903.0
Radium-228	904.0
Strontium-89	905.0
Strontium-90	905.0
Tritium	906.0
Uranium	908.0
Uranium	ASTM-D 5174-02

NEW YORK
state department of
HEALTH

Nirav R. Shah, M.D., M.P.H.
Commissioner

Sue Kelly
Executive Deputy Commissioner

LAB ID: 11798

April 01, 2014

MS. MARY L. TURNER
EBERLINE SERVICES-OAK RIDGE LAB
601 SCARBORO ROAD
OAK RIDGE, TN 37830

Certificate Expiration Date:
April 01, 2015

Dear Ms. Turner,

Enclosed are Certificate(s) of Approval issued to your environmental laboratory for the current permit year. The Certificate(s) supersede(s) any previously issued one(s) and is(are) in effect through the expiration date listed. Please carefully examine the Certificate(s) to insure that the categories, subcategories, analytes, and methods for which your laboratory is approved are correct. In addition, verify that your laboratory's name, address, lead technical director, and identification number are accurate.

Pursuant to NYCRR Subpart 55-2.2, original certificates must be posted conspicuously in the laboratory and copies shall be made available to any client of the laboratory upon request.

Pursuant to NYCRR Subpart 55-2.6, any misrepresentation of the Fields of Accreditation (Matrix - Method - Analyte) for which your laboratory is approved may result in denial, suspension, or revocation of your certification. Any use of the Environmental Laboratory Approval Program (ELAP) or National Environmental Laboratory Accreditation Program (NELAP) name, reference to the laboratory's approval status, and/or using the NELAP logo in any catalogs, advertising, business solicitations, proposals, quotations, laboratory analytical reports, or other materials must include the laboratory's ELAP identification number and distinguish between testing for which the laboratory is approved and testing for which the laboratory is not approved.

If you have any questions, please contact ELAP at the New York State Department of Health (NYS DOH), Wadsworth Center, PO Box 509, Albany NY, 12201-0509; by phone at (518) 485-5570; by facsimile at (518) 485-5568; and by email at elap@health.state.ny.us.

Sincerely,

Stephanie E. Ostrowski

STEPHANIE OSTROWSKI, PH.D.
Program Director
Environmental Laboratory Approval Program

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2015
Issued April 01, 2014

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. MARY L. TURNER
EBERLINE SERVICES-OAK RIDGE LAB
601 SCARBORO ROAD
OAK RIDGE, TN 37830

NY Lab Id No: 11798

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Radiological Analytes	
Gross Alpha	EPA 900.0
Gross Beta	EPA 900.0
Photon Emitters	EPA 901.1
Radium-226	EPA 903.0
Radium-228	EPA 904.0
Strontium-89	EPA 905.0
Strontium-90	EPA 905.0
Tritium	EPA 906.0
Uranium (Activity)	EPA 908.0

Serial No.: 50856

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2015
Issued April 01, 2014

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. MARY L. TURNER
EBERLINE SERVICES-OAK RIDGE LAB
601 SCARBORO ROAD
OAK RIDGE, TN 37830

NY Lab Id No: 11798

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Drinking Water Metals III	
Uranium (Mass)	ASTM D5174-97 02.07
Radiological Analytes	
Gross Alpha	EPA 900.0
Gross Beta	EPA 900.0
Photon Emitters	EPA 901.1
Radium-226	EPA 903.0
Radium-228	EPA 904.0
Strontium-89	EPA 905.0
Strontium-90	EPA 905.0
Tritium	EPA 906.0
Uranium (Activity)	EPA 908.0

Serial No.: 50855

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

Appendix C
Eurofins Air Toxics, Inc.
Laboratory Quality Assurance
Program Manual

LABORATORY QUALITY ASSURANCE MANUAL

(LQAM)

Rev. 26

March 5, 2014

Quality Assurance Manager: Bahar Amiri

The Laboratory Quality Assurance Manual is effective as of the date of the signature of the Quality Assurance Manager

EUROFINS AIR TOXICS, INC.
180 BLUE RAVINE ROAD, SUITE B
FOLSOM, CA 95630
(800) 985-5955
atl@eurofinsus.com

LABORATORY QUALITY ASSURANCE MANUAL

Approvals

Robert Mitzel, President — Date: 3/5/14

Heidi Hayes, Technical Director — Date: 3-5-14

Sepideh Saeed, Laboratory Director — Date: 3-5-14

Bahar Amiri, Quality Assurance Manager — Date: 3-5-14

REVISION LOG

Revision: 23	**Effective Date: 10-05-2012**	
Section	**Justification**	**Changes**
Entire Document	Initial Version	
Revision: 24	**Effective Date: 11-28-2012**	
Section	**Justification**	**Changes**
Cover page; Appendices Table of Contents; Section 1.3; Section 2.1; Section 2.6.2; table added to Section 6.3; Appendices numbering arrangement	NELAP Concordance, Quality Systems Internal Audit, and minor transcription errors	Added address, phone number to cover page, and appendices to Table of Contents. Statements added to the sections cited to be in compliance with NELAP requirements.
Revision: 25	**Effective Date: 02-22-2013**	
Section	**Justification**	**Changes**
Section 1.1; Section 2.1 Organizational Chart; Section 2.6 Qualifications and Responsibilities; Section 5.5 Sample Return/Disposal; Section 6.3 Equipment and Instrumentation; Section 8.1 Scope of Testing; Appendices A,D, and F	ISO 17025 Concordance and product testing methods – Chambers addition.	Updates made throughout document regarding product testing and Chambers information. Specified sections include the required information.
Revision: 26	**Effective Date: 03-05-2014**	
Section	**Justification**	**Changes**
Cover page; Appendices including Method Manuals, Organizational Chart, terms and definitions, and references.	Appendices were updated to correspond to the most current SOPs, methods, DoD, and TNI definitions.	General formatting and spelling errors corrected throughout the entire document.

TABLE OF CONTENTS

10. ASSURING QUALITY OF TEST RESULTS

11. AUDITS AND INSPECTIONS

12. CORRECTIVE AND PREVENTIVE ACTION

13. SERVICE TO CLIENTS

APPENDICES

1. INTRODUCTION

The purpose of the Laboratory Quality Assurance Manual is to provide a framework to outline the quality systems at Eurofins Air Toxics, Inc.

1.1 Our Unique Promise of Value

Eurofins Air Toxics is the global leader in the The NELAC Institute (TNI) National Environmental Laboratory Accreditation Program (NELAP) for accredited vapor-phase environmental analytical laboratory services, and is also ISO/IEC 17025:2005 accredited for environmental chamber chemical emissions testing and associated analytical laboratory services.

Eurofins Air Toxics supports public and private sectors, including engineering and consulting firms, manufacturers, industry, government, retailers and others by offering a wide variety of certified air methods as well as emissions testing of consumer and building products and materials. Eurofins Air Toxics provides unmatched quality, capacity, and technical expertise to deliver an outstanding service experience to clients worldwide.

1.2 Mission Statement

Eurofins Air Toxics, Inc. is an analytical and environmental laboratory specializing in the analysis of vapor-phase contaminants and air quality parameters. Our business is guided by four key principles:

1) Providing unmatched data integrity
2) Establishing long-term relationships
3) Delivering quality client service
4) Exceeding client expectations

1.3 Quality Policy

The Executive Management Group recognizes quality as a key element of the laboratory's standard of service. This group supports the laboratory's commitment to quality as defined by NELAP and ISO 17025.

The Quality Policy Statement gives employees clear requirements for producing analytical data that is scientifically valid, legally defensible, accurate, impartial, and of known and documented quality, through strict adherence to the Quality Policy Statement. The Quality Assurance Officer wrote the Quality Policy Statement with final approval from the Technical Director. The policy cannot be

revised without the Technical Director and Quality Assurance Officer's approvals. Employees are trained on the components of the Quality Policy Statement during their orientation. All employees sign the statement as agreement to implement the policy in all aspects of their work. The statement is as follows:

We strive to provide the highest quality data achievable by:

- Describing clearly and accurately all activities performed; documenting "real time" as the task is carried out; understanding that it is never acceptable to "back date" entries; and should additional information be required at a later date, the actual date and by whom the notation is made must be documented.
- Providing accountability and traceability for each sample analyzed through proper sample handling, labeling, preparation, instrument calibration/ qualification, analysis, and reporting; establishing an audit trail that identifies date, time, analyst, instrument used, instrument conditions, quality control samples (where appropriate and/or required by the method), and associated standard material.
- Emphasizing a total quality management process and commitment to continuous improvement that provides accuracy; strict compliance with agency regulations and client requirements, giving the highest degree of confidence; and understanding that meeting the requirements of the next employee in the work-flow process is just as important as meeting the needs of the external client.
- Providing thorough documentation and explanation to qualify reported data that may not meet all requirements and specifications but is still of use to the client, and understanding this occurs only after discussion with the client on the data limitations and acceptability of this approach.
- Responding immediately to indications of questionable data, out-of-specification occurrences, equipment malfunctions, and other types of laboratory problems with investigation and applicable corrective action; and documenting these activities completely, including the reasons for the decisions made.
- Providing a work environment that ensures accessibility to all levels of management and encourages questions and expressions of concern to management regarding quality issues.

We each take personal responsibility to provide this quality product while meeting the company's high standards of integrity and ethics, understanding that improprieties, such as failure to conduct the required test, manipulation of test

procedures or data, or inaccurate documentation, will not be tolerated. Intentional misrepresentation of activities performed is considered fraud and is grounds for termination.

1.4 Statement of Values

At Eurofins Air Toxics, we strive to be the BEST in everything that we do. Our very existence is based on our continued ability to provide innovative, dependable, and cost-effective environmental services to our clients. We CARE about our clients as well as our co-workers and manage our daily activities to build relationships based on mutual TRUST, HONESTY, and RESPECT. We are LEADERS in our field and accept the risks associated with building new frontiers in our professional lives. Our strength comes from our TEAMS for through them we can achieve our goals.

1.5 Certifications, Accreditations, and Registration

Accreditation/Certification is the process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications and/or standards. It is the one generally accepted method by which a laboratory such as ours can demonstrate its capability of generating acceptable, professional, quality test results in those areas in which it claims competence. To this end, we have actively sought accreditation by organizations offering it in areas relevant to our technical expertise. We strive to ensure that the facility, equipment, procedures, records, and methods used by Eurofins Air Toxics laboratory in the testing of environmental samples are in compliance with the requirements of these standards.

Appendix C lists accreditations held by Eurofins Air Toxics, Inc. in support of environmental and product testing work. Current copies of all scopes of accreditation are kept on file in the Quality Assurance Department.

2. ORGANIZATION AND PERSONNEL

2.1 Organizational Structure

Eurofins Air Toxics' management organization includes six core areas: Operations, Information Technology (IT), Client Services, Research, Sales and Marketing, and Finance and Administration. The management staff includes executives, directors, managers, and group leaders. Each operating area is lead by a manager and/or a group leader. In the absence of a member of the laboratory and operational management team, deputies are appointed as follows:

Position	Deputy
President	Technical Director or appointee
Technical Director	Quality Assurance Manager or appointee
Quality Assurance Manager	Technical Director or appointee
Laboratory Director	Technical Director or appointee
Vice President of VOC Materials Testing	Technical Director or appointee
Managers/Group Leaders	Laboratory Director

Eurofins Air Toxics' senior executives and managers are committed to following and assuring compliance with the TNI Standard as defined in this Laboratory Quality Assurance Manual (LQAM). Each manager is responsible for implementing and maintaining systems as they affect their teams and for participating in their respective role in the management systems as outlined in the LQAM.

An Organizational Chart is presented in Appendix D of this manual. This organizational structure is created in a way to avoid any potential for conflicts of interest or undue pressure that might influence the technical judgment of analytical personnel.

2.2 Management Responsibilities

Management and/or supervisor is defined as group leaders, managers, and directors, and positions above those. The following is a list of management responsibilities:

- Personnel hiring and training
- Supervision of personnel
- Ensuring quality of data produced
- Resources allocation
- Directing daily work operations, including scheduling of work
- Maintaining awareness of technical development and regulatory requirements
- Assessing laboratory capacity and workload
- Contributing to the continuous improvement of the laboratory operation
- Providing resources to ensure a safe work environment

- Providing resources to ensure a work environment free of undue pressures
- Communicating problems and concerns to senior and executive management to enlist a higher level of support for corrections and continuous improvement, ensuring compliance with the requirements of NELAP and ISO 17025
- Ensuring that corrective actions are carried out in an appropriate and agreed upon time frame

The Technical Director ensures that the laboratory's policies and objectives for quality of testing services are documented in this quality manual. The Technical Director must assure that the manual is communicated to, and understood and implemented by all personnel concerned.

2.3 Overview of the Quality Assurance Program

The Quality Assurance (QA) Department is responsible for developing planned activities the purpose of which is to provide assurance to all levels of management that a quality program is in place within the laboratory, and that it is functioning in an effective manner that is consistent with the requirements of NELAP and ISO 17025. Although Eurofins Air Toxics is a wholly owned subsidiary of Eurofins Scientific, the Quality Assurance and quality systems described in this manual are specific to Eurofins Air Toxics.

2.3.1 Quality Assurance Manager

The Quality Assurance Manager ensures that the quality system is followed at all times. The QA Manager reports directly to the Technical Director in order to maintain independence from business operating units and facilitate communications regarding quality-related issues. The QA Manager has no direct supervisory responsibility for the generation of technical data to avoid any conflict of interest in administrating the QA program. The QA Manager has the final authority to stop work that compromises the laboratory's integrity or data quality. The situation must be investigated and appropriate corrective action must be put in place before the QA Manager will authorize the resumption of work. The specific duties of the QA Manager are communicated in job description format.

2.4 Quality Assurance Responsibilities

The Quality Assurance team is responsible for implementing and maintaining Quality Assurance procedures throughout the laboratory. This is accomplished

via coordination and dissemination of internal and external assessment information, review of Standard Operating Procedures (SOPs) to document variances taken to published methods, monitoring of the Quality Assurance Manual to ensure consistency with actual practices, maintenance of an ongoing Corrective Action Program with quarterly reports to the senior management team, a leadership role in employee training, data review, and other quality control-related programs.

The QA team is free from any commercial, financial, or production pressures when making assessments or decisions regarding the quality of work produced or effectiveness of the quality systems.

2.5 Communication of Quality Issues to Management

Communication between the Quality Assurance (QA) team and other management teams occurs on a regular basis (typically via bi-weekly status meetings). Information regarding outstanding corrective action items, upcoming assessments, assessment results, and/or general observations are discussed and documented via a database of agenda notes. The QA databases along with the Laboratory Information Management System (LIMS) database are used to compile a Quarterly Quality Assurance Status Report, which is distributed to the senior management team for review.

2.6 Personnel Qualifications and Responsibilities

Full resumes and specific position descriptions for all personnel are located in Human Resources (HR) Department files. In addition, department managers have copies of position descriptions for their staff.

2.6.1 Executive Team

President: Provides leadership that ensures the founding mission and core values of the company are put into practice. The President leads programs relating to the development of long-range strategy, quality systems, financial infrastructure and sales. The President also provides day-to-day leadership and management of programs for overseeing the processes and resources necessary for establishing long-range service objectives, plans, and policies in cooperation with the Board of Directors. The President is responsible for the measurement and effectiveness of both internal and external processes by providing accurate and timely feedback on the operating condition of the company. In addition, the President directs the definition and operation of the laboratory production

by fostering a success-oriented and accountable environment within the company.

Technical Director: Provides oversight for the quality systems and technical performance of the laboratory, and manages technical support, the project management team, and the QA Manager. The Technical Director is responsible for developing products and solutions to meet client and industry needs, and also oversees the validation process of current and new products to ensure quality objectives are met and documented as defined.

Laboratory Director: Responsible for managing the operations of the laboratory, profit/loss relating to operations, laboratory efficiency improvement in software and instrument automation, and serves as the primary interface between finance, HR, IT, and sales/marketing. The Laboratory Director has the overall responsibility of ensuring customer satisfaction goals are met while elevating the skill and training of key technical staff as well as assuring that state-of-the-art instrumentation and capital assets are in place to meet global customer needs.

Vice President of VOC Materials Testing: Responsible for the promotion and demonstration of expertise in chamber testing, product emissions, and indoor air quality (IAQ), providing scientific leadership in these areas. Represents Eurofins Air Toxics on technical committees and at technical conferences and trade shows as they relate to the promotion and demonstration of expertise in chamber emissions testing and IAQ. Has the overall responsibility for establishing and maintaining a strategy and business plan for the emissions and product testing markets in the U.S.

2.6.2 Management Team:

Laboratory management and personnel are free from any commercial, financial, or production pressures when making technical judgments or decisions regarding the quality of work produced.

Information Technology Manager: Oversees all aspects of software engineering and development, database administration, and network administration. The IT manager is instrumental in designing and implementing model work-flow processes, defining user requirements, and proposing software design and implementation to satisfy long-term company business goals. This role provides established policies and

procedures to ensure continuous database and server environment integrity and reliability.

Quality Assurance Manager: Responsible for overseeing the quality systems in the laboratory. Key to the Quality Assurance role is a focus on continuous improvement through effective monitoring of systems and evaluation of non-compliance and corrective actions. To support the quality systems, the Quality Assurance Manager leads the internal and external audit programs, negotiates audit resolution, and oversees the effectiveness of the Corrective Action Report (CAR) program. The QA Manager is tasked with providing timely feedback to front-line managers and bench staff regarding quality programs and also a big-picture assessment to senior management. Additionally, the QA Manager ensures required documentation and certifications are current and accurate, including regulatory accreditations, the LQAM, and SOPs.

Managers/Group Leaders: Responsible for day-to-day operations of the laboratory or specific departments. The Group Leaders oversee technical operations, sample analysis, data entry, report generation, provision of resources, and other related areas. In addition, they are responsible for employee management and review. Group Leaders report directly to the Laboratory Director. Managerial decisions are made by the Laboratory Director in their absence.

2.6.3 Laboratory Staff and Responsibilities

It is the primary responsibility of laboratory staff to produce quality data within the framework of each individual method and within the parameters of the laboratory's quality control guidelines. It is also the responsibility of staff to identify existing problems or inefficiencies, and to improve the processes of the laboratory whenever possible. Duties for these personnel typically include:

- Sample preparations
- Performance of analytical tests
- Calibrations, operation, and maintenance of instruments
- Standard and reagent preparation
- Sample storage
- Data entry
- Data package preparation

2.7 Training

The experience and training received by personnel is of great importance to Eurofins Air Toxics' clients and regulatory agencies. Accurate training documentation is the responsibility of both employees and their supervisors. On a routine basis, the supervisor reviews and signs training documentation to verify that it is complete and current.

Each laboratory analyst being trained to perform a new analysis is required to perform an initial Demonstration of Capability (DOC) and meet the requirements for accuracy and precision before working independently on the test methods. Typically this is accomplished by the successful analysis of at least four aliquots of a laboratory quality control sample. However, there are certain tests that are not required by the mandated test method or regulation to perform the above procedure (e.g., PM10). In this case, the analyst's proficiency demonstration is satisfied by documentation of having read, understood, and agreed to follow the SOP, specific department or method forms and procedures, and observation by scientist or senior analyst.

Management personnel are responsible for planning ongoing professional growth and development activities for an employee through on-the-job training and/or internal and external training courses so that an employee can maintain a current skill set to match job responsibilities.

An annual performance review based on job accountabilities, objective measures, and pre-defined standards is completed by management personnel for each employee. This assessment is documented and maintained. Input is obtained from other managerial personnel as needed.

2.7.1 New Hire Training

New employees learn about personnel and safety policies as well as business strategies through a formal process administered by our Human Resources Department and the Safety Committee. All new employees are also required to attend the Quality Assurance Orientation course. Completion of this course is documented in the employee's Training Record. The course outline includes:

- Introduction to QA
- Definitions of SOPs and LQAM
- How to use CARS
- Logbook protocol
- Chain-of-custody procedures

- Training Documentation
- Overview of Eurofins Air Toxics classes including Ethics and Integrity courses
- Overall Training Record organization and upkeep

New employee training continues with review and signing of the Eurofins Air Toxics Ethics Policy (Form F1.56), a review of the Quality Assurance Manual, and signing of the Quality Policy. Upon completion of those, employees move on to analytical method training if required for their position. Other non-testing training materials may be required by the departments.

In general, the laboratory staff reviews the department's SOPs and/or the regulatory method as well as the instrument manual. The employee will then observe while an experienced analyst prepares samples and operates the instrument. Training includes sample handling and preparation, documentation protocols, calibration procedures, QC requirements, data management, data reporting and troubleshooting.

2.7.2 Ongoing Training

After successful completion of the initial Demonstration of Capability, all laboratory staff must demonstrate continued proficiency. Whenever there is a change in test method, instrument method type, and/or personnel a new DOC must be performed. At least once per year, each analyst must demonstrate continued proficiency on assigned technical methods. The QA Department notifies personnel via e-mail whenever a new SOP is generated or a current SOP is updated. Employees responsible for that method or procedure must read the new or updated SOP within 30 days and document the review in the LIMS SOP Tracker module. In addition, the Laboratory Quality Assurance Manual and the Chemical Hygiene Plan must be annually reviewed by all employees.

Employees are re-trained if an issue or investigation warrants that it is a necessary corrective action. Management provides direction as to when employee re-training is required, and to the extent of the re-training.

2.8 Employee Safety

Laboratory staff may, on occasion, be exposed to handling of solvents, compressed gases, calibration standards, or other hazards. Eurofins Air Toxics designates an assigned Safety Officer and several staff members who comprise

the Safety Committee. Some members are 40-hour OSHA-trained and respirator-fitted.

Employee education in the safe handling and disposal of these materials is accomplished as follows:

- Each new employee is given a safety tour of the facility within the first two days of employment. Documentation of this orientation appears in the employee's Training Record.
- The Safety Committee meets frequently to discuss safety concerns and ways of improving safety in the work place.
- The Safety Committee schedules ongoing safety training throughout the year.
- If special precautions must be taken to perform a method, a safety section is included in the method SOP or in a stand-alone SOP which discusses protocols and other measures for risk reduction through exposure prevention.
- Safety Data Sheets (SDSs), formerly Material Safety Data Sheets (MSDS), are maintained for each chemical used on-site. The SDSs are accessible to personnel in the library area immediately outside the standards room and/or electronically through the chemical inventory database (CISpro) at all times. SDSs are also accessible on the Internet from product vendors.
- The Safety Committee members are assigned to duties that include hazardous waste disposal, incident or spill management, scheduling staff training, safety site assessments, Chemical Hygiene Plan review, and the overall leadership of the Safety Program.

2.9 Client Services/Project Management Responsibilities

The Project Management group is responsible for organizing and managing client projects. Clients are assigned a Project Manager who serves as their primary contact. It is the Project Manager's responsibility to act as client advocate by communicating client requirements to laboratory personnel and ensuring that clients provide complete information needed by the laboratory to meet those requirements. All client verbal and electronic communications are documented by the project managers in the LIMS Contacts module. In addition to information management, project management responsibilities include:

- Coordinating and preparing proposals in conjunction with technical staff, including review of project-specific documents and negotiations of variance requests

- Documentation of project requirements
- Coordinating and communicating turnaround-time (TAT) requirements
- Scheduling sample submissions, sample containers, and sample pickup via Eurofins Air Toxics courier service
- Informing clients of deviation from their contract

2.10 Confidentiality

Strict confidentiality is maintained in all of Eurofins Air Toxics dealings with clients. All employees are required to protect company data, including client names and/or test results from disclosure to any third party. This policy is presented to employees in SOP #99 and during their orientation period.

Clients are promptly notified if their data is subpoenaed or requested by a regulatory or legal body.

In order to ensure the confidentiality of our systems and procedures within the laboratory, it is Eurofins Air Toxics' policy to restrict the distribution of our internal procedures to clients. Clients are, however, permitted to review the laboratory's procedures while on-site as part of an audit or visit. Based on this policy, the laboratory requests that any document viewed is not shared or made available to any third parties without the permission of Eurofins Air Toxics.

2.11 Operational Integrity

All employees sign an Employee Ethics Statement on their first day of employment. Employees responsible for generating, handling, or reviewing laboratory data understand that Eurofins Air Toxics' mission is to perform all work with the highest level of integrity. Shortcuts or generating results to suit a client's purpose, rather than adhering to good scientific practices, is not considered acceptable under any circumstances. Any violation of the laboratory ethics policy results in a detailed investigation that could lead to termination. Examples of violations of data integrity are listed below:

- Knowingly recording inaccurate data
- Fabrication of data without performing the work needed to generate the information; this includes creating any type of fictitious data or documentation
- Time travel or adjusting clocks on computerized systems to make it appear that data was acquired at some time other than the actual time

- Manipulation of data for the express purpose of passing systems suitability or quality control criteria
- Selective use of data generated, or not using data that was legitimately generated to impact the outcome of a test
- Executing significant deviations from approved test methods and procedures without prior approval from Eurofins Air Toxics management and/or the client

If an issue does arise which could compromise data integrity, personnel are instructed to perform the following activities:

- Clearly document the situation and maintain all data generated. There is a big difference between poor judgment and fraud. Fraud usually involves intent to conceal an action taken. Therefore, the more documentation that is maintained the less likely an action is considered fraudulent if further scrutinized. All documentation of the inquiry and subsequent disciplinary actions will be maintained by both the Technical Director and the Human Resources Department for at least five years.
- When out-of-specification results or quality control-type issues are detected, all supporting data and relative background information must be documented and presented for management review. Problem resolution and client contact, as applicable, must also be documented.
- Any questionable situations and decisions must be reviewed with a supervisor.
- Questionable or uncomfortable issues are brought directly to QA Manager or a member of the QA Department as part the QA “open door” policy. If an employee desires to remain anonymous, he or she is encouraged to report to the designated laboratory staff ombudsman. The designated ombudsman will meet separately with management and the employee involved, ensuring anonymity.

3. BUILDINGS AND FACILITIES

3.1 Facility

The Eurofins Air Toxics laboratory occupies approximately 35,000 square feet of space in Folsom, California, including 7,000 square feet of office space. The single-story building is custom-designed to suit the specifications of an air laboratory. Design criteria included floor plans to accommodate segregation of conflicting tests and provide an environment that is conducive for cross-functional work teams. The main instrumentation laboratory is based on an “open” concept

in which walls were removed to promote a sense of community and teamwork. Wide hallways with alcoves were designed to encourage congregation and discussion. The number of private offices was minimized so that barriers between management and staff are absent. Elements of the quality system are evident throughout the facility design. The facility's map is provided in Appendix F.

3.2 Security

Security at Eurofins Air Toxics is maintained through a controlled access system. Representatives of State, Federal, and private entities have access to the laboratory facility and records during normal business hours. Guests and employees must enter/exit through Sample Receiving or the reception area. All visitors must sign in and out upon arrival and departure. After work hours, the building is secured and linked to a commercial security agency. The security system is equipped with perimeter alarms, motion sensors, and speakers that monitor background sounds. Heat-activated fire alarms are monitored by an outside agency. A fire alarm also activates the security system. Security and controlled access protocols are described in SOP #30.

4. DOCUMENT CONTROL

4.1 Controlled Documents at Eurofins Air Toxics

It is Eurofins Air Toxics' policy to restrict the distribution of internal procedures to clients, and we discourage the distribution of company confidential documents outside of the facility. Clients are permitted to review our procedures while on-site as part of an audit or visit. Any documents that are distributed are only done so with the approval of QA.

4.1.1 Quality Policy Manual and Company Policies

Eurofins Air Toxics' Quality policies and Quality Systems must comply with all State and Federal requirements for those programs for which the laboratory maintains accreditation.

All Eurofins Air Toxics employees are required to read the Quality Assurance Manual within 30 days of release of the latest version and maintain current documentation in their Training Record binders. The Quality Assurance Manual is available to all employees electronically on a shared server located at O:\QA\LQAM. A hard copy is also available in the QA department.

4.1.2 Laboratory Standard Operating Procedures (SOPs)

The SOPs at Eurofins Air Toxics detail the work processes used on a regular basis that are to be conducted and followed within the organization. They document the way activities are to be performed to facilitate consistent conformance to technical and quality system requirements and to support data quality. These SOPs can be administrative or technical. All employees should maintain a record of review of the most current SOPs.

4.1.3 Work Instructions (at the department level)

The intent of these procedures or documents is to define in greater detail the specific “how to”. The level of detail in these documents must be sufficient so any appropriately trained person can perform the task accurately.

4.1.4 Logbooks, Forms, and Instructions

The intent of these documents is to provide documented evidence to support Eurofins Air Toxics quality systems and operations. They are used as part of regular laboratory operations to record necessary information.

4.2 Document Approval, Issue, Control, and Maintenance

The Quality Assurance Department is responsible for the approval, issue, control, and maintenance of all documents that are part of the laboratory’s quality systems including, but not limited to, the Quality Assurance Manual (LQAM), Standard Operating Procedures (SOPs), Logbooks, Forms and Instructions, Certificates of Analysis (C of As), and calibration and training documents.

All documents issued to personnel in the laboratory as part of the quality system shall be reviewed and approved for use by Technical Director, Laboratory Director, and Quality Assurance Manager prior to use.

The LQAM and SOPs are reviewed to ensure they remain accurate and current. The frequency of review is either annual at the least or as needed, depending on the procedure. Upon generation of new or updated documents, all copies of obsolete documents are removed from the laboratory and its computer network, then archived or destroyed as appropriate. Pertinent staff members are notified of the updates. A new revision number is assigned to the LQAM or SOP at every review.

All technical changes must have the approval of the Technical Director, the Laboratory Director or Vice President of VOC Materials Testing, and the Quality Assurance Manager.

Detailed instructions regarding document control and how to write SOPs are available in SOPs #46 and #119.

4.3 Laboratory Logbooks and Forms

Procedures are in place to ensure that all data is traceable, authentic, complete, and retrievable. Logbooks, forms, and instructions are created and distributed by the Quality Assurance Department as needed. Used logbooks are returned to QA for archival. The QA Department maintains a master index to uniquely number and identify each logbook and form distributed. Logbooks can contain blank or preformatted pages. They are bound and uniquely identified, and have sequentially pre-numbered pages.

4.4 Archival and Storage of Documents

The majority of documents at Eurofins Air Toxics are stored electronically. Documents which remain in hard-copy format include chain-of-custody forms (COCs), Data Review Checklists, scanned packets (run logs, spectral defenses, manual integrations, etc.), FedEx/UPS air and freight bills, and most logbooks. All other hard-copy documentation is stored in its specific workorder folder. The hard-copy workorder folder is placed in a bar-coded storage box for long-term storage. Bar codes are maintained in an inventory log. An off-site company archives the boxes using the bar-coding system. The storage company provides one-day retrieval service upon request.

Used logbooks are returned to Quality Assurance for archival and remain in the QA Department for no less than five years.

5. SAMPLE HANDLING

5.1 Sample Collection

It is the responsibility of the client to submit representative and/or homogeneous and properly preserved samples of the system from which they are collected. In all cases, field sampling personnel are ultimately responsible for having expertise and knowledge in air sampling methodology or product/materials collection protocols sufficient to ensure that the defensibility of the data will not be compromised due to deficiencies in the field sampling, handling, or transportation. General information regarding the proper use of sampling media

provided by Eurofins Air Toxics is available as a resource for field personnel. The laboratory provides sample containers, chain-of-custody forms, sampling labels, chemical ice packs (if appropriate), shipping containers, custody seals (per client request), and a copy of the Sample Acceptance Policy.

Air sampling media provided by a qualified vendor or prepared by the laboratory for field use is certified for cleanliness. The laboratory's media cleaning process is typically verified using batch certification protocols. Individually certified canisters are also available per specific client request.

5.2 Sample Receipt and Entry

5.2.1 Sample Receipt

Samples can be received at the laboratory during normal laboratory operating hours. Receipt occurs in one of three ways:

- Commercial courier
- Eurofins Air Toxics courier service
- Personal delivery

Upon arrival at the laboratory, samples are received and inspected following Eurofins Air Toxics' Sample Acceptance Policy as outlined in SOP #50. This SOP establishes specific guidelines for sample acceptance, which are generally accepted practices under U.S. Environmental Protection Agency (USEPA), Department of Defense (DoD), ISO, and NELAP protocols.

5.2.2 Sample Entry

As soon as is practical after sample receipt, the samples are entered into LIMS. Samples awaiting log-in are stored in temporary holding areas, at appropriate storage conditions to maintain sample integrity.

At the time of entry, the LIMS system assigns a unique laboratory sample number to each sample. This number is sequentially assigned, then a label is generated and is attached to the sample container.

A sample acknowledgment in the form of a Sample Receipt Confirmation prints from LIMS for each sample delivery group (SDG), which is the same number as the workorder. This notification is sent to the client to confirm sample receipt and entry.

5.2.3 Sample Rejection Policy

Any time a sample is received in a condition that does not meet the method requirements, if there is doubt about the suitability of items received, if items do not conform to the description provided, or the testing required is not clear or specified, the condition of the sample is clearly documented on a Sample Discrepancy Report (SDR). The SDR is delivered to the Project Manager for review and communicated to the client as needed. Directions on next steps, which may include canceling the sample or proceeding with qualifiers and/or narrative, are documented on the SDR. Details are outlined in SOP#50.

5.3 Sample Identification and Tracking

A sample label is generated for each sample, and in addition to the assigned Eurofins Air Toxics' sample number the following information is printed on the label: workorder number, laboratory sample ID, and, if needed, a sample release date. For canister analysis, the label is not affixed directly to the canister but attached with a tag.

To ensure traceability of results, the unique sample number assigned is used to identify the sample in all laboratory data documentation, including logbooks, instrument printouts, and final reports.

5.4 Sample Storage

After entry into LIMS, samples are placed in an assigned and identified storage location until needed for analysis. Room temperature, refrigerated, and freezer storage are available, and samples are stored in accordance with regulatory, method, or client directions. The LIMS system is used to assign storage locations for bar-coded media, which promotes orderly storage of samples. Sample storage locations for sorbent and condensate samples requiring refrigeration are monitored for accurate temperature control.

When a canister, bag, or product sample is scheduled for analysis, the analyst obtains custody of the sample by scanning the canister tag or sticker bar code as well as the bar-coded destination location of each individual sample. The scanned information is electronically transmitted to LIMS to reflect the custody of canister and bag samples at all times. All other media samples are logged into the Internal Extractable Sample Tracking Logbook and the pertinent storage area.

5.5 Sample Return/Disposal

Samples are released for disposal upon satisfactory completion of analysis unless prior contractual arrangements have been made. Product samples are held for a minimum of 30 days after satisfactory completion of the analysis, unless otherwise specified by the customer. The release of samples is electronically documented in the LIMS tracking system via scanning of the canisters and bags. This ensures verification of completion of all analyses including all samples in each workorder. Samples are released following the procedures outlined in SOP #63.

Sample disposal varies based on the sampling media. Whole air samples are vented through a charcoal scrubber, while liquid samples are disposed of according to procedures noted in SOP #24.

5.6 Chain of Custody

Samples received by the laboratory must be documented using a chain-of-custody (COC) form and relinquished following standard EPA-approved guidelines, including the following:

- Unique sample name or number
- Location, date, and time of collection
- Canister number (if applicable)
- Collector's name
- Preservation type (if applicable)
- Matrix or product type
- Any special remarks

Additional information may be required depending on the requested analysis.

A copy of the signed COC will be e-mailed to the client in conjunction with the Sample Receipt Confirmation.

Once a sample is received by the laboratory, the internal chain-of-custody procedure is followed.

Disclaimer: *Eurofins Air Toxics assumes no real or implied responsibility or liability for client-related field sampling and shipping activities. It is the responsibility of the individual client to ensure that referenced methodologies are followed with respect to sample collection and shipment to the laboratory. Air sampling media and equipment should only*

be used by experienced field engineers. It is the ultimate responsibility of the client to be knowledgeable both in sample preservation requirements as well as relevant State, Federal, and international shipping requirements. Any time a chemical substance is collected using Eurofins Air Toxics media, the client bears sole responsibility for understanding and abiding by the laws involving shipment of potentially hazardous substances by common carrier.

6. TECHNICAL REQUIREMENTS – TRACEABILITY OF MEASUREMENTS

6.1 Reagents and Solvents

The reliability of Eurofins Air Toxics' analytical results can be directly affected by the quality of reagents used in the laboratory. Procedures are in place to control labeling, storing, and evaluation of these materials. All purchased supplies, reagents, solvents, and standards are verified as acceptable and meeting criteria for analysis prior to use. The Eurofins Air Toxics' Chemical Hygiene Plan (CHP) provides safety information in regard to the storage and handling of laboratory chemicals. All reagent certificates and Safety Data Sheets (SDSs) are retained by the laboratory (see section 2.8).

6.2 Calibration Standards

Written calibration procedures are required, where applicable, for all instruments and equipment used in the laboratory. The source and accuracy of standards used for calibration purposes are integral to obtaining quality data. Requirements for calibration are provided in each analytical method including specifications for the standard used. Calibration measurements made by the laboratory must be traceable to national standard of measurement (e.g., NIST) where available. Certificates of Analysis are maintained for each material, as applicable.

Standards are usually purchased from commercial suppliers either as neat (pure) compounds or as solutions with certified concentrations. The accuracy and quality of these purchased standards are documented on the C of A, and hard-copy certificates are maintained on file in the laboratory. Upon receipt at Eurofins Air Toxics, material is labeled with a date of receipt and stored appropriately.

Stock standard solutions are recorded in the proper standard logbook and are assigned a unique standard code number. When a working standard is prepared, the compound(s), standard code number, date prepared, analyst, expiration date, and solvent are noted in the working standard logbook. All working standards are kept in containers and at temperatures that will not alter their integrity. All containers are clearly labeled with concentrations, unique standard code number,

and expiration date. Standards are not to be used in the laboratory past their expiration date.

6.3 Equipment and Instrumentation

The laboratory is equipped with all equipment and instrumentation required for testing the scope of work it supports. All equipment and instrumentation is maintained in proper working order. Eurofins Air Toxics' major equipment capabilities are summarized in the table below:

Major Instrumentation

Number	Instrumentation
24	GC-MS
7	Gas Chromatographs with various detectors (TCD, PID, FID, SCD, ECD)
2	HPLC-UV
11	Air Concentrators
7	Automated Thermal Desorption Units
3	Liquid Auto-samplers
1	Extractors
60	119 L Dynamic Environmental Chambers
1	Micro-chamber/Thermal Extractor
1	Air Generator
1	Industrial Air Compressor
1	Air Humidification System

6.3.1 General Requirements

- Equipment and instrumentation are assigned a unique identifier designation to identify them within the data documentation.
- An equipment logbook is established in conjunction with installation and is readily available to document all incidents that pertain to the equipment and instruments as they occur.
- All test, measuring, and inspection of laboratory systems, equipment, and instruments used at Eurofins Air Toxics are routinely calibrated and maintained in accordance with applicable Standard Operating Procedures.
- A member of the technical group, or another designated individual, performs routinely scheduled maintenance and calibration of laboratory equipment as required by laboratory procedures. These activities are documented.

- If appropriate standards or expertise for calibration or maintenance are not available in-house, the operation is conducted by an outside service firm.
- All equipment taken out of service is tagged accordingly.

6.3.2 Standard Operating Procedures

Information regarding operation, maintenance, and calibration of equipment and instrumentation are found in respective SOPs. The procedures include a routine schedule for preventative maintenance and calibration as applicable, along with acceptance criteria and remedial action to be taken in the event of failure. These procedures are maintained in the document control system and reviewed on a regular basis to verify they remain current and accurate. Equipment manuals are also available to provide additional information with regard to operations and maintenance.

6.3.3 Maintenance

- Equipment maintenance is performed as either a preventative or corrective operation.
- Preventative maintenance procedures and schedules for each piece of equipment are assigned where applicable. Preventative maintenance operations are performed by an analyst, scientist, senior scientist, or contracted manufacturer's representative or service firm personnel. Documentation is maintained for the procedures performed as part of the preventative maintenance operation. It is the responsibility of Group Leaders to ensure that a preventative maintenance schedule is addressed by a procedure where appropriate and is followed.
- A supply of commonly needed replacement parts is maintained by the laboratory.

6.3.4 Calibration

- Calibration is the establishment of, under specified conditions, the relationship between the values/response indicated by a measuring instrument or system and the corresponding known/certified values associated with the standard used. Some types of calibrations are performed within a set of frequency (e.g., daily), while others provide intermediate checks to ensure that the instrument response has not changed significantly.

- All measuring and testing equipment having an effect on the accuracy, precision, or validity of calibrations and tests are calibrated and/or verified on an ongoing and routine basis. Methods for calibration of instruments and equipment vary widely with the nature of the device and the direction given by analytical procedures, department procedures, or manufacturer recommendations. Frequency of calibration can also depend on additional factors, including robustness of the instrument or equipment and the frequency of use.
- Calibration information is recorded in a logbook that is associated with the instrument/equipment and/or a calibration certificate is maintained and/or data printouts are generated to document the activity.
- Calibration measurements are traceable to national standard of measurement (e.g., NIST) where available. Physical standards, such as NIST-certified weights or thermometers are re-certified on a routine basis. Calibration certificates are maintained on file, where applicable, to indicate the traceability to national standard of measurement.
- Calibration failures are documented in the logbook for the instrument and/or within the data printouts from the instrument.
- After repair, adjustments, or relocation that could affect instrument response, calibration/verification activities are performed, as applicable, before the unit is returned to service.
- Analytical data is not reported from instrumentation or equipment that fails to meet calibration requirements.

6.4 Computerized Systems and Computer Software

6.4.1 Computer Usage

Eurofins Air Toxics provides computer equipment for employees to use as a tool in performing their work. Computer equipment is the property of Eurofins Air Toxics and is to be used in accordance with defined terms and conditions. The laboratory's goal is to provide standard hardware and software that meets the needs of the user.

6.4.1.1 Physical security of computer systems: It is company policy to protect computer hardware, software, and data documentation from misuse, theft, unauthorized access, and environmental hazards. All of the laboratory servers are housed in a locked office, which maintains favorable environmental conditions to allow for optimal server performance. Access to the laboratory's networks is granted by the Systems Administrator or Information Technology (IT) Manager. Network access is tightly controlled for the entire company. Users maintain individual network accounts and are allowed to access specific areas of the network based on the privileges assigned to them. A user is granted access to only those areas needed to fulfill his or her job function.

6.4.1.2 Passwords: All software used to reduce sample data or generate sample reports is password-protected; users are granted rights to these systems based on a "read/write/none" privilege system. The following procedures apply regardless of what system(s) is being utilized:

- Passwords must be kept confidential.
- Users must log-out of a system when not in use to prevent unauthorized access.
- Forgotten passwords can only be reset by the IT Department or by an appropriate System Administrator.
- Network passwords automatically expire every 90 days. The computer prompts a user to change the password when the expiration date nears.

6.4.1.3 Computer viruses: Eurofins Air Toxics continuously monitors its computer network for computer viruses. Anti-virus software is employed to detect viruses on the Windows network. Employees must report any virus concerns to the IT department as soon as possible. Employees who share files between their home computer and the laboratory should install anti-virus software on their home computer. If an employee does not have such software, the laboratory can suggest various no-cost anti-virus software products.

6.4.1.4 Internet and e-mail System: The e-mail system is used primarily for Eurofins Air Toxics business purposes. The Employee Handbook provides additional information in regard to system usage. Employee access to the Internet is restricted to those employees who have a business need for it. All employees have access to e-mail. All Internet and e-mail activity is subject to monitoring. All messages created, sent, or received over the Internet are property of Eurofins Air Toxics and can be regarded as public information. E-mail and Website filtering software is utilized.

6.4.1.5 Software Policy:

Eurofins Air Toxics' Software Policy is as follows:

- Copyright laws protect software, and Eurofins Air Toxics' intent is to abide by all software agreements.
- Software purchases must be formally requested and approved by management, IT Department, and/or validation personnel, as necessary.
- All software is used in accordance with applicable license agreements.
- Employees are not to install any software on computer(s) unless authorized by the IT Department.
- Employees must not give software to outsiders (e.g., clients, contractors, etc.), unless approval is granted by management.
- Users must not make copies of any licensed software or related documentation without permission. Any user that illegally reproduces software is subject to civil and criminal penalties including fines and imprisonment.

6.4.1.6 Computer system backup, data restoration, and data archival: All data systems are backed up on a daily, weekly, and monthly basis using a modified "grandfather-father-son" (GFS) rotation protocol. Specifically, these backups are conducted on the servers responsible for all laboratory production data files and databases (i.e., Project Management files, analytical data, audit trails, Quality Assurance documents, etc.). A daily incremental backup is scheduled to run each night Monday through Saturday. The daily incremental backup is limited to files modified the same day. On Sunday, a weekly full backup of all files on each server is completed. At the end of each month, a

full backup of each data system is conducted. This monthly backup tape is then placed in permanent storage. The permanent historical backup tapes are stored in an off-site data storage facility. Data is not removed from the server until at least three permanent monthly backup tapes have been created. This ensures that no archived data will be lost due to corruption of the magnetic tape. A more comprehensive description of the laboratory's electronic data archiving system can be found in SOP #55.

6.4.1.8 Remote access to computer systems: With special permissions, employees are able to remotely connect to the laboratory computer network through a VPN system. When logging in, users are authenticated with their Windows account and password.

6.4.2 System and software verification: Before each new computer system or significant modification of an existing system is implemented in the laboratory, the following requirements must be met:

- Required documents – Describe the required system functionality and specification (e.g., Software Development Change Control, Change Control Log, IT Logic New Rule or Rule Update)
- Design documents – System overview, screen design, report layout, data description, system configuration, file structure, and module design
- Testing documentation for system development/verification – structural testing of the internal mechanisms and user testing of the installation and system qualification.

7. PURCHASING EQUIPMENT AND SUPPLIES

7.1 Procurement

The primary materials procured by the laboratory are analytical instrumentation and software, media and reagents including standards, carrier gases and cryogens, miscellaneous laboratory supplies, computer hardware and software, and service contracts.

Control of the purchase of these items and services is maintained using a standard purchase order system described in SOP #105 and outlined below:

- Purchase requests must be approved by a director or manager.
- An assigned purchase order (PO) number is entered along with the date, vendor, and requester.
- An evaluation of the supplier is conducted to determine whether it has been deemed a qualified vendor.
- Requires that upon receipt or delivery of services the product is inspected by the purchasing agent and compared to the packing slip and/or request for services.
- Each PO is matched with invoices prior to payment to insure that purchased items or services were delivered as expected.

Purchasing documents are maintained by the Accounting Department, calibration certificates are maintained by the Quality Assurance Department, and Certificates of Analysis for reagents and media are maintained by laboratory personnel.

7.2 Supplier Evaluation

Suppliers and vendors are evaluated in accordance with SOP #105 to assure that the quality of the products purchased meet the quality expectations of Eurofins Air Toxics, Inc. and do not interfere in the quality of testing. A laboratory database is maintained with a list of approved vendors.

8. ANALYTICAL METHODS

8.1 SCOPE OF TESTING

Soil vapor, landfill gas, indoor and outdoor ambient air, source (stack) emissions, and other types of air-phase samples are analyzed in accordance with official published methods or validated in-house methods. Method modifications made by Eurofins Air Toxics, Inc. are detailed in a summary of modifications table in the method SOP. Measurement and analysis of volatile organic compound (VOC) emissions from products using environmental chambers are performed in accordance with the relevant ASTM, EPA, and ISO methods. Specific operational and assessment parameters required for product compliance to voluntary and regulatory labels and testing are outlined in documents such as CDPH/EHLB SM V1.1 (CA 01350), ANSI/BIFMA M7.1, and AgBB.

The methods used by Eurofins Air Toxics are approved by a broad range of regulatory agencies.

A list of methods covered under the laboratory's NELAP accreditation can be found in the table in section 8.2.

Eurofins Air Toxics specializes in and has expertise with the following types of projects:

- Vapor Intrusion investigations
- Environmental assessments
- Remediation system monitoring (soil vapor extraction)
- Landfill gas characterization
- Source emissions testing
- Soil vapor surveys
- Ambient air monitoring
- Indoor air quality (IAQ)
- Material emissions using environmental chambers

Appendix E contains summaries for each commonly performed analytical procedure in the laboratory. Each summary contains the following information:

- A brief method description
- Laboratory variances to method compendium or other regulatory reference methodologies
- Tables containing analyte lists, Reporting Limits (RLs), Limits of Quantitation (LOQs), and quality control (QC) acceptance criteria
- A table of calibration and QC procedures

This Quality Assurance Manual references methods in a general manner; specific procedures used by the laboratory can be found in the method-specific SOPs.

8.2 Analytical Test Methods

Eurofins Air Toxics' NELAP-certified analytical methods, parameters, instrumentation, sampling media, holding times, and SOP numbers are summarized in the table below:

Method	Parameter	Type	Sampling Container	Holding Time in days	Eurofins Air Toxics SOP
TO-14A/TO-3	BTEX/TPH	GC/FID/PID	Summa Canister Tedlar Bag	30 3	43
TO-4A/TO-10A	Pesticides/PCBs	GC/ECD	PUF	7	26
TO-11A	Aldehydes/ Ketones	HPLC/UV	DNPH Cartridge	14	11
TO-12	Non-methane Organic Carbon (NMOC)	GC/FID	Summa Canister Tedlar Bag	30 3	36
TO-13A	PAHs/ Semi-volatiles	GC/MS	XAD/PUF	7	3/10
TO-14A/TO-15	VOCs	GC/MS	Summa Canister Tedlar Bag	30 3	6/38/83/114
TO-17	VOCs	GC/MS	Sorbent Tube	30	5/109/110/ 112/122
ASTM D-1946	Fixed Gases, CH_4, C_2+	GC/TCD/FID	Summa Canister Tedlar Bag	30 3	08
ASTM D-1945	Fixed & Natural Gases	GC/TCD/FID	Summa Canister Tedlar Bag	30 3	54
ASTM D-5504	Sulfur Gases	GC/SCD	Tedlar Bag	24 hours	13
PM10/TSP	Particulate Matter	Mass	Quartz Filter	14	66

8.3 Method Validation

As part of the initial test method evaluation for new standard methods, analytical runs must be performed the same way an analyst would perform an initial Demonstration of Capability (DOC) to evaluate precision and bias along with a Method Detection Limit (MDL) study as applicable.

Non-standard methods, including laboratory-developed methods, standard methods outside their intended scope or application, and requested changes to existing instrumentation will follow a planned process explained in detail in SOP #107 and outlined below:

- Measurement Quality Objectives (MQOs) – should be clearly outlined prior to validation.

- Development of Test Plan – Technical Director and assigned personnel are responsible for the development of such plan.
- Validation – Implementation of the test plan with documentation of all results will be reviewed by the Technical Director.
- Review and Approval – Review of performance against the MQOs, supporting documents, and written procedures is performed by the Technical Director. After approval, the QA Manager reviews for completeness and finalizes the method for production.

8.4 Procedural Deviations

Eurofins Air Toxics communicates and addresses procedural deviations in the following ways:

- Modifications to standard methods made by Eurofins Air Toxics are detailed in a summary of modifications table in the analytical method SOP. The modification table is also included in the laboratory narrative of the final data report.
- Differences between a project request and laboratory standard protocol are documented in a variance table created by the laboratory's project chemist for submission with the proposal to the client. Agreement is documented by the client's initials and date in the approval column or with written documentation from the client that all variances have been approved.
- If a sample received did not meet the established criteria for quality testing, the Sample Receiving Department will issue a Sample Discrepancy Report (SDR), and the Project Manager will communicate the discrepancy to the client. If the client still wants the sample to be processed, the discrepancy will be narrated in the final report.
- Other analytical procedural deviations that are within allowable variations established for every method and listed in the method SOPs are discussed with the client, and if accepted the sample results will be reported with a narrative of the deviation and the affected result will be flagged accordingly.
- Analytical procedural deviations that are not within allowable variations and directly affect the sample result will require the initiation of a Corrective Action Report request.

The Corrective Action Program is explained in detail in section 12 of this Quality Manual.

9. INTERNAL QUALITY CONTROL CHEC S

9.1 Laboratory Quality Control Samples and Acceptance Criteria

9.1.1 Blanks: For the whole air methods for which no sample preparation step is required, a blank is a designated sample designed to monitor for contamination originating from the analytical system. The Laboratory Blank is comprised of clean, humidified air or nitrogen. A Laboratory Blank is analyzed after any applicable standards and prior to the analysis of project samples. A blank is also analyzed in the event saturation-level concentrations are incurred to demonstrate that contamination does not exist. The blank and the field samples are treated with the same internal standards and surrogate standards and carried through the entire analytical procedure. For methods requiring a sample preparation step (e.g., TO-11A and TO-13A), a Laboratory Blank is prepared using un-sampled media and extracted alongside the batch of field samples. Ideally, blanks demonstrate that no artifacts were introduced during the preparation and/or analysis process. The specific acceptance criterion for each test is given in the analytical method and is usually based on the required Reporting Limit (RL).

9.1.2 Surrogates: Surrogates are organic compounds that are chemically similar to the analytes of interest but are not naturally occurring in environmental samples. For GC-MS methods and some GC methods, the recovery of the surrogate standard is used to monitor for unusual matrix effects and gross sample processing errors, and to provide a measure of recovery for every sample matrix. When required by the analytical method, surrogates are spiked into all the field and QC samples to monitor analytical efficiency by measuring recovery on an individual sample basis. The percent recovery is determined and compared to the acceptance criteria. Acceptance criteria limits are set as required by the method or based on a statistical determination from laboratory data.

9.1.3 Matrix Spikes: Matrix spikes are not required QC for whole air samples collected in Summa canisters. Accurately spiking target compounds into an evacuated canister prior to deployment in the field for sample collection or post-sample collection is neither practical nor technically appropriate. Therefore, matrix spiking is performed only on samples submitted as part of a sampling train, such as condensates, or on extractable samples, provided they are submitted in duplicate for matrix spike and in triplicate for the matrix spike duplicate. It is the responsibility of the client to provide additional samples to fulfill any method

requirements regarding matrix spikes. When applicable, matrix and matrix duplicate spiking is performed using a subset of target analytes. Recoveries and demonstrated reproducibility values that do not meet the acceptance criteria are flagged and explained in the laboratory narrative.

9.1.4 Laboratory Control Samples: Laboratory control samples (LCS) are samples of known composition that are analyzed with each batch of samples to demonstrate laboratory accuracy. The LCS is prepared by fortifying clean matrix with known target concentrations. In the case of non-extracted batches, the LCS is generally analyzed daily prior to sample analysis, but could also serve as an end check standard. Percent recovery is calculated and compared to acceptance criteria, which are set as required by the method or based on a statistical determination from laboratory data.

9.1.5 Sample Duplicates and Laboratory Control Sample Duplicates: A duplicate is a second aliquot of a sample that is treated identically to the original to determine precision of the test. To compare the values for each compound, the relative percent difference (RPD) is calculated by dividing the difference between the numbers by their average. Precision for analytes that are not typically found in environmental samples is determined by analyzing a pair of Laboratory Control Samples (LCS), and comparing the RPD for the spiked compounds. The acceptance criteria are described as a maximum for the RPD value as required by the method or based on a statistical determination from laboratory data.

9.1.6 Internal Standards: Internal standards (IS) are organic compounds that are chemically similar to the analytes of interest but are not naturally occurring in environmental samples. For extractable methods and when required by the method, IS are added to every field and QC sample typically after extractions but prior to analysis. For all GC-MS methods an IS blend is introduced into each standard and blank to monitor the stability of the analytical system. Comparison of the peak area of the IS is used for quantitation of target analytes. The IS peak area and retention time also provide a check for changes in the instrument response and chromatographic performance. The acceptance criteria are stipulated in the analytical method.

9.1.7 Second Source Check: A second source check is analyzed using either the Laboratory Control Sample (LCS) and/or an Initial Calibration Verification (ICV). The second source is a standard that is made from a solution or neat compound purchased from a different vendor than that

used for the calibration standards. For some organic custom mixes, the same vendor but a different lot and preparation is used. This ensures that potential problems with a vendor supply would be evident in the analysis. Some areas of the laboratory use continuing calibration verification standards as a second source from the initial calibration.

9.2 Quality Control Sample Frequency and Corrective Action

Each analytical method defines the frequency for required quality control (QC) samples. A summary is provided in Appendix E. The corrective action required when a QC result fails to meet acceptance criteria is also given. If the method reference requires the use of specific limits, the laboratory uses the published limits that are documented as part of the analytical method. Many methods require that each laboratory determine their own acceptance criteria based on statistics from performance of the method. In these cases, the limits are available to the analyst and are entered into the laboratory computerized QC system described in SOP #48. Statistically determined acceptance criteria are frequently subject to change as the laboratory recalculates its control limits. Due to their dynamic nature, acceptance criteria are not included in this manual.

9.3 Quality Control Charts

Quality control (QC) results entered into the computer are used to generate control charts that are plotted via computer and can be accessed at any time by all analysts and by the Quality Assurance Department. The system charts results from surrogates and laboratory control samples. These charts provide a graphical method for monitoring precision and bias over time. The computerized quality control system is used to report QC data to clients and to collect data for assessment of precision and accuracy statistical limits.

9.4 Measurement Uncertainty

As stated in ISO 17025, “All uncertainty components which are of importance in a given situation shall be taken into account using appropriate methods of analysis” (5.4.6.3).

This means the laboratory must determine the uncertainty contribution of all steps in the testing process such as equipment, calibration, standards, reagents, preparation, etc. Since, in most methods, the laboratory control sample (LCS) goes through the entire process of preparation to analysis, all factors that would contribute to uncertainty is evident through the LCS results. As such, LCSs are performed with every batch of samples where appropriate for the method.

Measurement uncertainty is calculated as two times the standard deviation of the LCS recoveries for the group and date range of data points selected for all applicable methods. This is reported as a percentage. Reports for uncertainty shall be generated and submitted to the Quality Assurance Department for review on an annual basis. At this point, it is not necessary to apply or report the uncertainty determination with sample results. When a client requests the measurement uncertainty it is applied by multiplying the determined analyte concentration by the uncertainty percentage.

10. ASSURING QUALITY OF TEST RESULTS

10.1 Data Management

At a minimum, data management is initiated when Eurofins Air Toxics receives samples from the client. More often, the process begins with client communication of their needs and requirements for a specific project and/or testing. The Project Managers are responsible for entering this information into the client services modules of LIMS. Upon receipt of the samples, a unique tracking number is generated based on this information in the project profile. At this point, computer technology becomes an integral part of tracking the samples through laboratory operations.

10.2 Data documentation

Analytical data generated in the laboratory is collected through the associated data system or is manually documented in bound logbooks. Analysts review data as it is generated to determine that the instruments and systems are performing within specifications. If any problems are observed during an analytical run or the testing process, corrective action is taken and documented.

Procedures are in place to ensure that all data is traceable, authentic, and complete. The following general requirements outline the Eurofins Air Toxics' system for logbooks, notebooks, and documentation recording:

- Observations, data, and calculations are recorded at the time they are made and are identifiable to the specific task.
- Entries are legible, signed, and dated.
- Errors are corrected in a manner that does not obliterate the original entry, initialed, and dated.
- Blank pages or substantial portions of pages which are left blank are crossed out to eliminate the possibility of data entry at a later date.

- Logbook pages and instrument printouts are signed and dated to indicate completion.
- At periodic intervals the Quality Assurance Department checks equipment/instrument logbook entries and temperature recordings for completeness, legibility, and conformance to procedures.
- At a minimum, the following is recorded as part of data documentation:
    - Date of analysis/operation
    - Initials/date of analyst performing test/operation
    - Identification of client sample(s) and material(s) analyzed
    - Materials, reagents, and standards used to perform the test/operation
    - Method used to perform test/operation
    - Equipment/instrumentation used to perform test/operation
    - Deviations, planned or unplanned, from the analytical method
    - Signature/date of person reviewing data documentation
- For computer-generated data, the following information is recorded:
    - Samples(s) analyzed/operations performed
    - Date of analysis/operation
    - Unique instrument identification
    - Name or initial/date of person operating the instrument
    - Name or initial/date of person reviewing data
    - Any manual notation, interpretations, or integrations made on instrument printouts are signed, dated, and reviewed.

10.3 Data Calculations

Most instruments either include or are connected to a data system programmed to perform calculations needed to reduce the raw data to a reportable form. All calculations are maintained in the instrument manuals and/or as part of the analytical method.

In many cases, data from the local instrument system are uploaded directly to LIMS for review and reporting. This direct upload eliminates the need to re-type data and any associated source of transcription errors from the analytical scheme.

Some instruments report data that require application of additional factors before the data is in final form. Analysts input these additional factors into the laboratory sample management system, where final calculations are performed.

10.4 Reporting Limits

It is important to ascertain the Limit of Quantitation (LOQ) that can be achieved by a given method, particularly when the method is commonly used to determine trace levels of analyte. The USEPA has established one method for determining Method Detection Limits (MDLs) from which LOQs can be extrapolated, which is summarized in the laboratory procedures.

MDLs are verified or determined annually on each instrument and are the basis for the LOQ used in the default reporting format. Because MDLs change each time they are re-evaluated, they are not included in this manual but are available at the laboratory and available to clients upon request.

For DoD-certified methods and compounds, quarterly evaluation of the LOQ and determination of Limit of Detection (LOD) is performed. The LOQ evaluation entails the calculation of precision and accuracy at the LOQ or Reporting Limit. The LOD for each compound is determined by analyzing a calibration standard or set of standards between the MDL and LOQ. The LOD is assigned the concentration at which the peak meets the signal-to-noise criteria.

The Reporting Limit used to determine whether a result is significant and reported as detectable is dependent upon agency and client requirements. A variety of formats are available and include use of the MDL, LOD, LOQ, method-specified limits, and project-specific limits.

10.5 Data Review

Final review and verification of the data is performed by a trained analyst or scientist using the sample results and quality control information entered into the laboratory sample management system. Another tool used for data review involves the use of proprietary in-house data validation software to review every data point generated and to alert the reviewer when manual integrations occur. The software is also programmed to report each analyte that does not meet acceptance criteria in the quality control and/or sample(s).

After determining that all necessary requirements for valid data are met, the reviewer electronically approves the data by updating the “Report Approved By” status with their initials. This action applies the electronic signature of the Technical Director. The computer is programmed with a list of approved reviewers for each test, and the system is password-protected to ensure that only qualified individuals verify the data.

10.6 Data Qualification

Data qualifiers are used to provide additional information about the results reported. The most typical use for data qualifiers is for results that fall below the quantitation limit. The data systems used to generate and report results are programmed to flag values in this range as estimated.

Other qualifiers are applied to advise data users of any validation issues associated with the data. The laboratory makes every effort to meet all of the requirements for generation of data. Occasionally, data is generated that does not meet all the method requirements due to sample matrix or other analytical problems. If the test cannot be repeated, or re-analysis would not yield more useable data, qualified data is reported. Qualifiers can be in the form of comments on the analytical report or flags applied to the results.

10.7 Data Reporting

When each analysis is completed, reviewed, and verified, a report is generated. The client receives a copy of the report containing the results of the analysis, plus comments added by the analyst when necessary. The report contains the electronic signature of the Technical Director. Copies of the reports and associated supporting raw data are retained in the Eurofins Air Toxics' archives.

Eurofins Air Toxics offers a variety of data levels and formats, from a basic report of sample and QC results only (Level II) to a comprehensive data package including all supporting quality control information and raw sample data (Level IV). The client directs the selection of report type. Various electronic formats are also available, formatted to client-specific file structure and sent via e-mail, direct upload, Website access, or commercial courier.

Client confidentiality of Eurofins Air Toxics' Web data is ensured by the use of a secured firewall Internet environment coupled with the use of a user ID and password to gain log-in access to the system.

If amendments to a final report are required due to omissions, errors, or additional requests, a workorder reissue is initiated. All reissues receive a unique workorder number to distinguish them from the original issue. Reissued reports require a reason for the reissue and date of the reissue in the laboratory narrative. The laboratory maintains all supporting documentation for the revision including corrections, additions, or deletions relative to the original report.

10.7.1 Reporting the Results

Analytical reports are printed with a cover page that summarizes all samples in that group. This page lists the Eurofins Air Toxics' assigned sample number and the corresponding client description. The cover page identifies the laboratory contact person's name and the laboratory's phone number in case there is a question about the report. Within this package, each page is uniquely identified and paginated. Analytical test results which meet all the requirements of NELAP and ISO 17025 are noted as so in the footer of the summary cover page.

10.8 Data Storage, Security, and Archival

Eurofins Air Toxics has documented procedures and instructions for the identification, collection, access, filing, storage, maintenance, and disposal of data records. Records are in the form of hard-copy paper records, electronic data files, magnetic tape, and CD-ROMs.

Eurofins Air Toxics maintains records to demonstrate conformance to specified requirements and the effective operation of its quality systems. Records are stored and maintained in such a way that they are readily retrievable in facilities that provide a suitable environment to minimize deterioration or damage and prevent loss. Retention time for the records is in accordance with NELAP's minimum five-year requirement and/or specific procedures or instructions.

The laboratory maintains all documentation necessary for historical reconstruction of data, as follows:

- Analysis reports
- Data logbooks
- Instrument printouts
- Correspondence and client files
- Instrument and equipment logbooks
- Quality Assurance records
- Corporate documents
- Electronic records

11. AUDITS AND INSPECTIONS

11.1 Internal Quality Assurance Audits

Internal audits are performed by trained Quality Assurance personnel following a schedule planned yearly by the Quality Assurance Manager or at any time by the request of management. The audits cover all quality systems including but not limited to documentation practices, training, and adherence to current SOPs and methodology.

The following areas are identified to be audited by Quality Assurance:

a. Operations
b. Support Services
c. Sample Receiving and Login
d. Project Management and Sales
e. Information Technology (IT)
f. Quality Assurance

A written report with findings, observations, and/or recommendations is presented to the audited personnel, the team leaders, and management by the auditor. Responses to findings and observations are then submitted to the Quality Assurance Department within 30 days.

All audit notes, documentation, and reports are scanned and filed on the QA network drive.

11.2 Management Review System

A review of the laboratory's systems is performed by senior management on a biannual basis to evaluate effectiveness, identify areas requiring improvement, and establish timelines and accountability in addressing agreed-upon action items. This review includes internal assessment of the quality program and laboratory operations and external assessment through client feedback and audits. Four types of reports are generated by management or designated personnel:

11.2.1 **Quality Assurance Status Report:** Summarizes the results of internal and external assessments, the numbers and types of Corrective Action Reports (CARs) generated, status of any outstanding CARs, a summary of client inquiries received, proficiency tests (PT) results, and the number and types of reissued sample reports.

11.2.2 **Production Status Report:** Summarizes performance against key metrics such as turnaround time, details changes in sample mix and sample numbers, and outlines resource needs.

11.2.3 **Client Assessment Report:** Summarizes feedback from clients based on daily communication with project management and sales team as well as feedback collected by a third party as part of our Client Satisfaction Index (CSI) determination.

11.2.4 **Safety Assessment Report:** Outlines the safety incidents and "near misses" for the quarter and lists site assessment deficiencies.

The reports and records of the meetings are stored on a secure drive with management-only access for a minimum of five years.

11.3 Client Audits and Agency Inspections

Clients may audit our facility as assurance that their objectives are being met and that the laboratory is compliant with all applicable regulations, data quality, and project requirements.

Client audits can range from a laboratory tour to an intensive inspection of technical operations, procedures, regulatory compliance, and/or review of specific projects. Clients can only review data that pertains to their projects, and a non-disclosure agreement must be signed as per SOP #99.

Inspections can be performed by investigators or auditors from the USEPA, DoD, state and other regulatory agencies, third party accreditors (ACLASS), or regulatory agencies outside of the U.S.

The Quality Assurance Department is assigned the responsibility of hosting and working with agency and client representatives.

The Quality Assurance role includes:

- Escorting the investigator(s)
- Ensuring all questions are answered promptly and accurately
- Making note of all unresolved issues
- Informing management of the audit status and outcome
- Responding to the audit report
- Ensuring that appropriate corrective action is completed

11.4 Proficiency Testing Program

11.4.1 Proficiency Testing Samples (TNI/DoD)

Proficiency testing (PT) samples are used to measure analytical accuracy, precision, and report completeness. To be accredited under TNI and DoD-ELAP, the laboratory contracts with an outside approved PT sample provider in each field of testing (FOT). Testing is limited by availability of samples that meet NELAP and DoD-ELAP criteria (noted below). The provider must be a NIST-accredited PT provider. It may be necessary to participate in more than one proficiency testing program to be evaluated for multiple interdependent analyte groups. Currently, Eurofins Air Toxics participates in PT programs for EPA Method TO-15, which is ISO 17025 compliant, TO-13A, TO-17 VI, formaldehyde and emissions testing. In each calendar year, the laboratory will complete a minimum of one PT sample for each analyte or interdependent analyte group.

The following policies apply to laboratory PT sample analysis and reporting:

- The samples shall be analyzed and reported to the PT provider within 45 calendar days of receipt or the specific deadline specified by the PT provider.
- The PT sample is received and logged into an electronic sample receiving database in the same fashion as field samples.
- The laboratory must follow the PT provider's instructions for preparing the PT sample.
- The laboratory management and bench chemist ensure that the PT samples are prepared, analyzed, and reported in the same fashion as field samples using the same staff, equipment, and methods.
- Initial and continuing calibrations for the PT sample are analyzed at the same frequency of field samples.
- The PT sample cannot undergo duplicate or replicate analyses that would not ordinarily be performed on field samples. The PT sample result cannot be derived from averaging the results of multiple analyses unless specifically called for in the reference method.
- The PT sample can only be analyzed on equipment leased or owned by the company and handled only by bona fide employees of the company.
- The analysis of PT samples by temporary or contract employees is explicitly forbidden.

- The laboratory shall not subcontract any PT sample or portion.
- The laboratory shall not knowingly receive any PT sample or portion from another laboratory.
- The laboratory shall not communicate in any fashion with another laboratory concerning the PT sample or results.
- The laboratory shall not attempt to obtain the PT sample result prior to reporting.
- The PT sample reporting forms provided by the sample provider will be used to report the results and will be maintained in the laboratory's record system.
- The laboratory shall maintain copies of all written, printed, and electronic records relating the analysis or reporting of the PT sample for a period of five years or as required by the applicable regulatory program.
- A CAR will be generated any time an analyte result fails the PT assessment. A copy of the PT results will be sent to the accrediting agency, and associated corrective action summary will be sent upon request.
- The laboratory authorizes provider to release any PT assessment information to the accrediting agency.
- The QA Manager must sign the PT results form and, by so doing, attests that the sample was analyzed and reported in the same fashion as a field sample and followed the PT provider instructions for preparation.
- The laboratory must notify its primary accrediting agency and any other agencies under reciprocity that it has enrolled with a particular PT provider.
- The laboratory must notify its primary accrediting agency and any other agencies under reciprocity in the event it wishes to change PT providers.
- For each analyte or interdependent analyte group for which proficiency is not available, the certified laboratory will establish, maintain, and document the accuracy and reliability of its procedures through a system of internal quality management.
- Results of any failed PT samples are summarized in the Quarterly QA Status Report.

11.4.2 Proficiency Testing Samples (Non-NELAP/DoD)

Occasionally proficiency testing (PT) samples are submitted along with field samples by private clients. The laboratory processes and reports the

samples in the same fashion as field samples. When the client notifies the laboratory that one or more analytes appear to have failed, the report is processed through the normal Client Inquiry Corrective Action Process. The QA Manager will carry out an assessment and investigation into the circumstances surrounding the proficiency results, including aspects relating to how the client prepared the sample for submission. The outcome of the assessment will be documented as a CAR and maintained on file for a period of five years. Results of any failed external PT samples are summarized in the Quarterly QA Status Report.

12. CORRECTIVE AND PREVENTIVE ACTION

12.1 Laboratory Investigations and Corrective Action

The Quality Assurance (QA) Department manages the Corrective Action Program and maintains the Corrective Action tracking database using the c.Support software program. A Corrective Action Report is initiated any time sample results are affected by non-conformance with established SOPs or program requirements, any time an external assessment results in a finding, any time there is a failed proficiency evaluation sample, and when a client inquiry results in a quality finding. The expectation is that any CAR should be resolved within 30 days.

The client is notified if there is an issue that could potentially affect the quality of sample results. The communication with the clients is recorded.

The software program tracks all parts of the CAR system: root cause investigation, immediate corrective action, long-term corrective action, and preventive action. It also tracks client communications regarding the incident. The QA Manager reviews all opened CARs for completeness and resolution.

Detailed information about the CAR process is described in SOP #61.

13. SERVICE TO CLIENTS

The Project Management System is defined in SOP #1. The following are brief descriptions of the elements comprising project management systems.

13.1 Review of Work Requests, Tenders, and Contracts

Eurofins Air Toxics places great importance on understanding client requirements for a project. The laboratory ensures, to the best of our ability, that client and project requirements are outlined and understood prior to acceptance

of the project, including required laboratory accreditations and nonstandard work requests. All inconsistencies are discussed and addressed with both the client and the technical laboratory staff before the project is initiated and samples arrive. This is achieved in various ways, including the review of client work plans, Request for Proposals (RFPs) project Quality Assurance Project Plans (QAPPs), requested analytical methods and protocols, business contracts, and quality agreements. A key client contact is assigned to oversee each project. Communication between the client and Eurofins Air Toxics technical staff is coordinated through the Project Managers. The Project Management group relays any project changes or modifications to the technical group. They also relay issues encountered by the laboratory back to the client.

13.2 Timely Delivery

Evaluating laboratory capacity, assignment of resources, and ability to perform specific projects is a joint responsibility between the Technical Director and the Laboratory Director. Eurofins Air Toxics recognizes that one of the most important aspects of the services offered is turnaround time.

To ensure timely delivery, many analysts are cross-trained to perform a variety of tests, and there is redundant equipment available in the laboratory creating operation flexibility for routine work. Larger projects are reviewed against capacity estimates before a bid is submitted in order to meet a client's schedule.

Management regularly monitors the status of turnaround time including those projects that have exceeded a current turnaround time. Proactive communication regarding potentially missed deadlines is expected from the laboratory management to the Project Managers to keep the client informed of report delivery status.

Any changes to the established timeline by the client or the laboratory must be communicated to the client or laboratory as soon as possible. Upon communication of changes, a new timeline is established and agreed upon by both parties.

13.3 Subcontracting

Occasionally, Eurofins Air Toxics subcontracts analyses to other laboratories if the requested testing is not routinely performed in our laboratory. Testing is only subcontracted with the client's knowledge and approval. Subcontract laboratories are selected based on their qualifications. If tests require a specific agency certification, only an appropriately certified laboratory will be used.

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LABORATORY QUALITY ASSURANCE MANUAL

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Appendix A

Terms and Definitions

(nine total pages including this cover)

Current as of March 5, 2014

TERMS AND DEFINITIONS

Accuracy: The degree of agreement between an observed value and an accepted reference value.

Active sampling: The process of collecting a sample using pump or vacuum source to pull a known volume of vapor through a sorbent cartridge, filter, or liquid impinger.

Ambient air: Outdoor air (also can include indoor air).

Analyte: The substance or component for which a sample is analyzed to determine its presence or quantity.

APH (air-phase hydrocarbons): Aliphatic and aromatic fractions identified in vapor-phase samples.

Approved: The determination by a state or federal accrediting agency that a certified laboratory may analyze for an analyte under the specified method.

Assessment: The process of inspecting, testing, and documenting findings for purposes of certification or to determine compliance.

ASTM International (formerly known as American Society for Testing and Materials)**:** Organization which develops international voluntary consensus-based standards.

Bag: An air-sampling container consisting of inert polymeric material.

Batch: A group of analytical samples (≤ 20) of the same matrix processed together, including extraction, concentration, and analysis using the same process, staff, and reagents.

BFB (4-Bromofluorobenzene): Compound used to verify that the mass spectrometer meets the tuning requirements of the method. Also can be used as an internal standard or surrogate.

Blank samples: Negative control samples used to assess potential contamination from sampling procedures or analytical processes. They can be field blanks or laboratory blanks.

BTEX: Benzene, toluene, ethylbenzene, and xylenes

Canister: A stainless steel spherical air-sampling device consisting of Summa polished or glass-lined internal walls and a leak-tight on/off valve.

Certificate of Analysis (C of A): An authenticated document, issued by an appropriate authority, that assures a regulated product has met its product specification and quality.

Chain of Custody (COC): The chronological documentation of the custody of an environmental sample from the time it is taken until it is disposed.

Contamination: The effect caused by the introduction of a target analyte from an outside source into the test system.

Continuing Calibration Verification (CCV): A component of Quality Control used to verify instrument linearity with respect to the Initial Calibration (ICAL). A CCV is analyzed at the beginning of every analytical sequence and then periodically depending on the method. Certain methods also include a CCV in every analytical sequence as an End Check.

Control charts: Statistical tools for monitoring the performance of a particular task on a continuing basis. The control chart is prepared for each test parameter after 20 determinations have been performed. The mean is plotted with the warning limits being ±2s and the control limits being ±3s (s = Standard deviation).

Corrective action: An action taken to eliminate the cause(s) of an existing nonconformity, defect, or other undesirable situation in order to prevent recurrence.

Corrective Action Report: See NCCAR.

Data reduction: A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality.

Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results by a specific method and meet measurement quality objectives.

Detection Limit (DL): The smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration with 99% confidence.

Difference (D): A measure of precision between the expected value and the actual value, typically used to measure performance of the daily CCV RRF as compared to the Initial Calibration average RRF.

DoD: U.S. Department of Defense

Duplicate sample: A sample collected for checking the preciseness of the sampling process. Duplicate samples are collected at the same time and from the same source as the study samples.

Equipment Blank: A sample that is known not to contain the target analyte, used to check the cleanliness of sampling devices. It is collected in a sampling container from a clean sample collection device and returned to the laboratory as a sample.

Field Blank: A sample that is known not to contain the target analyte, used to check for analytical artifacts or contamination introduced by sampling and analytical procedures. It is taken to the sampling site and exposed to sampling conditions, then returned to the laboratory and treated as an environmental sample.

Field Duplicate: A sample collected at the same time from the same source but submitted and analyzed as a separate sample.

GC (gas chromatograph): Analytical instrumentation used to resolve complex mixtures into individual peaks for identification and quantitation. Separation is achieved as chemicals are retained at varying rates by the column phase.

Holding time: The maximum time that a sample may be held prior to preparation or analysis.

HPLC (high-pressure liquid chromatography): A form of liquid chromatography used to separate compounds that are dissolved in solution (also known as high-performance liquid chromatography).

Impinger: A glass vessel used to contain collection solution through which a stream of air is bubbled for sampling purposes.

Initial Calibration (ICAL): Demonstration of a linear response to different concentrations of calibration standards within a defined range.

Initial Calibration Verification (ICV): Verifies the Initial Calibration using a different source standard from the one used for Initial Calibration.

Initial Demonstration of Analytical Capability: The procedure described in USEPA 40 CFR 136 Appendix A, used to determine a laboratory's accuracy and precision in applying an analytical method.

Instrument Blank: A sample that is known not to contain the target analyte, processed through the instrumental steps of the measurement process and used to determine the absence of instrument contamination prior to analysis of field samples.

Instrument Detection Limit (IDL): The concentration of the analyte that produces a signal greater than five times the signal-to-noise ratio of the instrument.

Interference: The effect on the final result caused by the sample matrix.

Internal Standard (IS): A measured amount of a certain compound added after preparation or extraction of a sample.

etones: Any of a class of organic compounds characterized by a carbonyl group attached to two carbon atoms.

ey Personnel: The laboratory director, technical director, quality assurance manager, and team leader, all of whom meet the requirements of the NELAP rule.

Laboratory Control Sample (LCS): An independent second source reference standard that goes through the same pretreatment and preparation procedures as the samples. It validates the accuracy of the Initial Calibration.

Laboratory Duplicate: An aliquot of the same sample that is prepared and analyzed at the same time.

Laboratory Information Management System (LIMS): A laboratory's electronic data system that collects, analyzes, stores, and archives records and documents.

Limit of Detection (LOD): The smallest concentration of a substance that must be present in a sample in order to be detected at the DL with 99% confidence.

Limit of Quantitation (LOQ): The smallest concentration that produces a quantitative result with known and recorded precision and bias.

Matrix: The component or substrate (e.g., surface water, drinking water, air, liquid waste) which contains the analyte(s) of interest.

Matrix Spike (MS): A sample prepared to determine the effect of the matrix on a method's recovery efficiency by adding a known amount of the target analyte to a specified amount of matrix sample for which an independent estimate of the target analyte concentration is available. It is used to evaluate accuracy.

Matrix Spike Duplicate (MSD): Duplicate of the matrix spike sample. Results are compared with MS to determine precision.

Mass spectrometer (MS): Analytical instrumentation used to identify and quantify chemicals utilizing spectral fragmentation patterns based on chemical structures.

Measurement uncertainty: Measurement uncertainty is the estimation of potential errors in a measurement process and is expressed as $\pm$ 2X(*s*) of the historical mean of LCS recoveries.

Method Detection Limit (MDL): The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero as determined from analysis of a sample containing the analyte in a given matrix (40 CFR Part 136, Appendix B, July 1995).

NCCAR (Non-conformance/Corrective Action Report): A report that identifies, communicates, tracks, and resolves a non-conformance.

NIST: National Institute of Standards and Technology

NMOC: Non-methane organic compounds

OSHA: Occupational Safety and Health Administration

PAHs (polycyclic aromatic hydrocarbons): Hydrocarbons made up of fused aromatic ring molecules.

Passive sampling: Sample collection conducted without the use of mechanical pumps or vacuums. Collection relies on principle of diffusion.

PCBs (polychlorinated biphenyls): Biphenyl compounds with chlorine atoms positioned on the benzene rings.

ppbv: parts per billion by volume

ppmv: parts per million by volume

Practical Quantitation Limit (PQL): A synonym for the standard of lowest concentration contained in the Initial Calibration. It is the smallest concentration of the analyte that can be reported with a specific degree of confidence.

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. Precision is usually expressed as standard deviation, variance or a range, in either absolute or relative terms.

Preservation: The temperature control or the addition of a substance to maintain the chemical or biological integrity of the target analyte.

Proficiency Testing (PT): A means to evaluate a laboratory's performance under controlled conditions relative to a given set of criteria, through analysis of unknown samples provided by an external source.

Proficiency Test (PT) sample: A sample, the composition of which is unknown to the laboratory and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria.

Quality Assurance (QA): An integrated system of activities involving planning, quality control, reporting, and quality assessment and improvement to ensure that the product meets defined standards of quality with a stated level of confidence.

Quality Assurance Project Plan (QAPP): An orderly assemblage of detailed procedures designed to produce data of sufficient quality to meet the data quality objectives for a specific data collection activity.

Quality Control (QC): A procedure or set of procedures intended to ensure that a product or performed service adheres to a defined set of quality criteria.

R: %Recovery

Relative Percent Difference (RPD): A measure of precision between two measurements calculated by dividing the absolute value of the difference between the measurements by their average and expressed as a percentage.

Reporting Limit (RL): The smallest concentration of an analyte that can be measured with a stated probability of significance. All Initial Calibrations contain a standard at the Reporting Limit. The Reporting Limit is never less than the Practical Quantitation Limit (PQL).

Reporting Limit verification: A re-quantification of the lowest concentration data point of an Initial Calibration to test the percent recovery of each component. Analyte recovery should be between 50–150% to verify detection limit accuracy.

Relative Standard Deviation (RSD): A measure of precision often used to evaluate linearity of an Initial Calibration. The relative response factor is calculated at each calibration level, and the RSD is calculated by dividing the standard deviation by the average value.

RRF: Relative Response Factor

RT: Retention Time

Safety Data Sheet (SDS): A technical document that contains information on the chemical make-up, use, storage, handling, emergency procedures, and potential health effects related to a hazardous material (formerly Material Safety Data Sheets).

Selectivity: The capability of a method or instrument to respond to the target analyte in the presence of other substances or things.

Semivolatile compound (SVOC): An organic compound which has a boiling point higher than water and which may vaporize when exposed to temperatures above room temperature.

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels of a target analyte.

Soil vapor (also referred to as "soil gas"): Vapor-phase volatile compounds that migrate or evaporate from contaminated soil.

Soil vapor extraction (SVE): A physical treatment process for in situ remediation of volatile contaminants in vadose zone (unsaturated) soils.

Standard Operating Procedure (SOP): A written document that details the steps of an operation, analysis, or action, the techniques and procedures for which are thoroughly prescribed and accepted as the procedure for performing certain routine or repetitive tasks.

Surrogate: A substance unlikely to be found in the environment that has properties which mimic the target analyte and that is added to a sample to check for analytical efficiency.

Target analyte: The analyte that a test is designed to detect or quantify.

Technical employee: A designated individual who performs the analytical method and associated techniques.

TIC: Tentatively Identified Compound

TNMOC: Total non-methane organic compounds

TPH: Total petroleum hydrocarbons

TRH: Total recoverable hydrocarbons, which are differentiated from total petroleum hydrocarbons (TPH) in that non-fuel-related peaks are subtracted from the TPH result but are included in TRH.

Trip Blank: A sample known not to contain the target analyte, which is carried to the sampling site and transported to the laboratory for analysis without having been exposed to the sampling procedures.

TVH: Total volatile hydrocarbons

Vapor intrusion (VI): The process by which vapors originating from contaminated soil or groundwater migrate through the subsurface into nearby buildings, potentially impacting indoor air quality.

VPH: Volatile Petroleum Hydrocarbons

CHAMBERS
TERMS AND DEFINITIONS

Air change rate: The flow rate of clean air into the chamber divided by the chamber volume. Also, the ratio of volume of clean, conditioned air brought into the emission test chamber or building space per unit time to the chamber or building space volume.

Air flow rate: Air volume entering the emission test chamber per unit time.

Air velocity: Air speed over the surface of the test specimen.

Aldehydes: Formaldehyde, acetaldehyde, and other carbonyl compounds detectable by derivatization with DNPH and analysis by HPLC.

Area specific flow rate: Ratio of the inlet air flow rate to the nominal surface area of the product or the product test specimen.

Background concentration: VOC concentrations in emission test chamber in the absence of a product test specimen.

CREL: Non-cancer chronic reference exposure level developed by Cal/EPA OEHHA. These are inhalation concentrations to which the general population, including sensitive individuals, may be exposed for long periods (10 years or more) without the likelihood of serious adverse systemic effects other than cancer.

Emission factor: Mass of VOC emitted per unit time from a specific unit area of product surface. Other unit measures such as product mass or length may be used as appropriate.

Emission rate: Mass of VOC emitted by an entire product or test specimen per unit time.

Emission test chamber: Non-contaminating, inert enclosure of defined volume with controlled environmental conditions for inlet air flow rate, temperature, and humidity used for determination of VOC emissions from product test specimens.

Loading factor: Ratio of the exposed surface area of the product or the test specimen to the volume of the building space or the emission test chamber.

Manufacturer's identification number: Unique product identifier from which a manufacturer is able to determine the product name, product category or subcategory, manufacturing location, date of manufacture, production line, and/or other pertinent identifying information for the product.

Product category: General group of similar products intended for a particular application and performance, such as VCT, laminated wood flooring, broadloom carpet, sheet vinyl flooring, plywood, OSB, interior paint, etc.

Product subcategory: Group of products within a product category having similar chemistry, construction, weight, formulation, and manufacturing process and which may have a similar VOC emissions profile.

Representative product sample: A product sample that is representative of the product manufactured and produced under typical operating conditions.

Sampling interval: Time over which a single air sample is collected.

Sampling period: Established time for collection of air sample from emission test chamber.

Specific emission rate: Emission rate normalized to the area, mass, or length of a product (i.e., equivalent to emission factor).

Test specimen: Portion of representative sample prepared for emission testing in an emission test chamber following a defined procedure.

TVOC: Sum of the concentrations of all identified and unidentified VOCs between and including n-hexane through n-hexadecane (i.e., C_6 – C_{16}) as measured by the GC/MS TIC method and expressed as a toluene equivalent value.

Ventilation rate: Same as air change rate.

Volatile organic compounds (VOCs): Carbon-containing compounds (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonates, and ammonium carbonate) with vapor pressures at standard conditions approximately ranging between those for n-pentane through n-heptadecane. For the purposes of this method, formaldehyde and acetaldehyde are considered to be VOCs.

Zero time: Time establishing the beginning of an emission test.

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Appendix B

Procedure Cross-Reference List

(Three total pages including this cover)

Current as of March 5, 2014

Procedure Cross-Reference List

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Appendix C

Certifications and Accreditations

(Two total pages including this cover)

Current as of March 5, 2014

Certifying Agency	Air Toxics Certificate	Basis of Certification/Approval	Location of Certificate and Parameter List
Arizona DHS	AZ0775	Onsite assessment (annual), LQAM and SOP	Laboratory internal network: O:\QA\Certifications
California DPH (Primary NELAP)	12282CA	Onsite assessment (biennial) LQAM, SOP and WP PTs	Laboratory internal network: O:\QA\Certifications
New York State DOH	11291	LQAM, Secondary NELAP	Laboratory internal network: O:\QA\Certifications
Oregon DHS (Primary NELAP)	CA300005	Onsite assessment (biennial) LQAM and SOP Review	Laboratory internal network: O:\QA\Certifications
Texas CEQ	T104704434-13-6	LQAM, Secondary NELAP	Laboratory internal network: O:\QA\Certifications
State of Utah DOH	CA009332013-4	LQAM, WP PT, Secondary NELAP	Laboratory internal network: O:\QA\Certifications
Washington DOE	C935-13	PT, Secondary NELAP	Laboratory internal network: O:\QA\Certifications
DoD-ELAP_ ISO/IEC 17025:2005	ADE-1451	DOD QSM for Environmental Laboratories v.4.2 Onsite assessment (biennial)	Laboratory internal network: O:\QA\Certifications
Virginia DCLS	2612	Secondary NELAP	Laboratory internal network: O:\QA\Certifications
New Jersey DEP	CA016	LQAM, SOPs, Secondary NELAP	Laboratory internal network: O:\QA\Certifications

All latest certificates and licenses are posted by the laboratory entrance.

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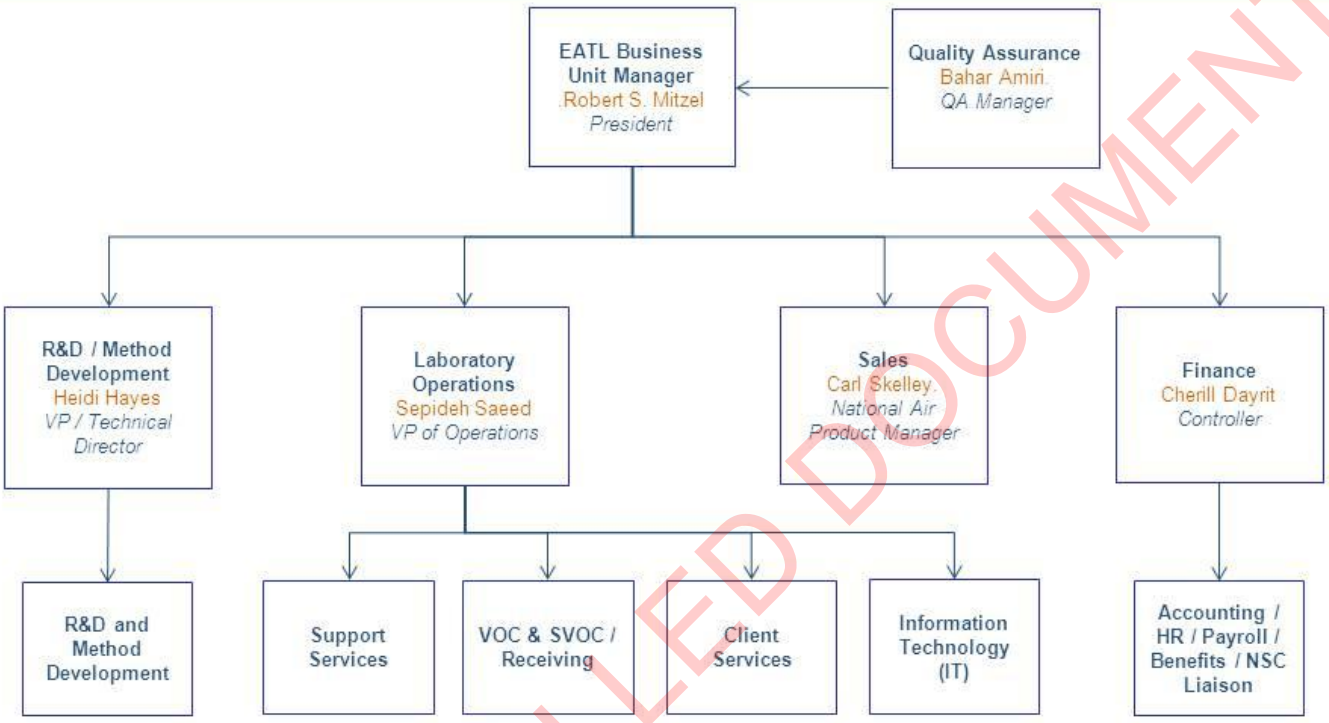
Appendix D

Organizational Charts

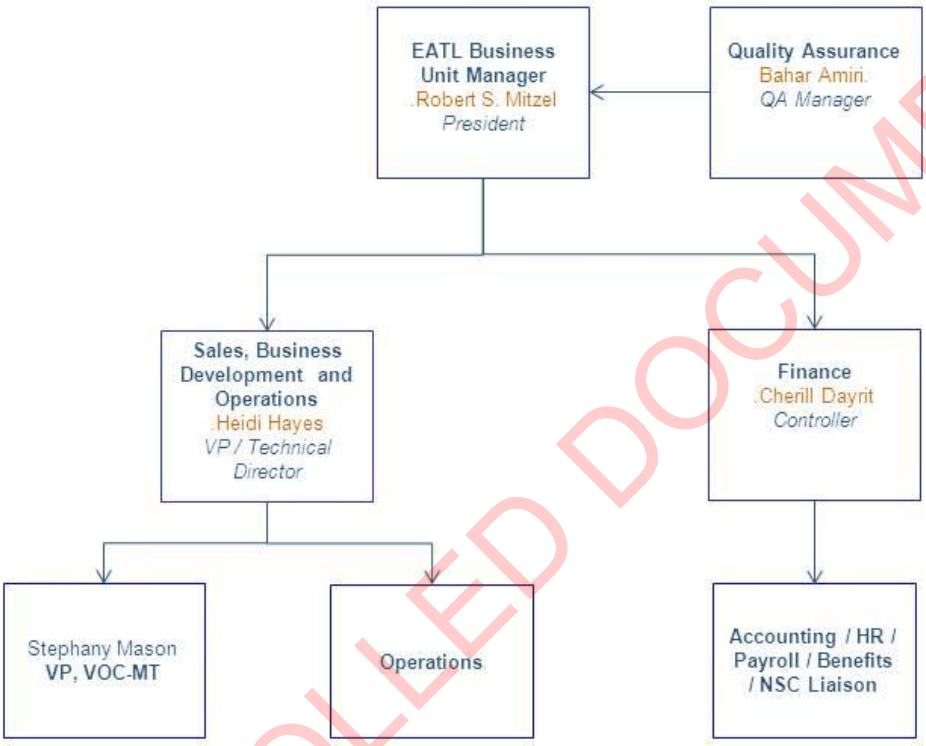
(four total pages including this cover)

Current as of March 5, 2014

Organization Chart – Eurofins Air Toxics, Inc.



Organization Chart – Product Testing



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Appendix E

Analytical Methods

(seventy-seven total pages including this cover)

Current as of March 5, 2014

ANALYTICAL METHODS

ANALYTICAL METHODS

Section 1.0

Method: Modified EPA TO-17 VOCs and SVOCs – General Applications

Eurofins Air Toxics SOP #5 Revision 15 Effective Date: December 23, 2013 Methods Manual Summary

Description: This method is an alternative to the canister-based sampling and analysis methods that are presented in EPA Compendium Methods TO-14A and TO-15. Sorbent sampling is also amenable to efficient collection and measurement of semi-volatile compounds that are prone to condensing on the surface of the canister. Thermal desorption gas chromatograph/mass spectrometer (GC/MS) can be applied to matrices beyond ambient air such as soil gas and materials emissions by carefully selecting the appropriate sorbent and sampling parameters. Single bed sorbents such as Tenax TA and Carbopack B can be utilized to collect a specific volatility range while multi-bed sorbent tubes are effective in collecting a wide volatility range. (See Air Toxics' TO-17 VI method for the multi-bed tube application.)

Samples are collected by drawing a measured volume of air through the sorbent tubes. Collection is performed using a low flow vacuum pump or a volumetric syringe attached to the outlet side of the tube. Analysis is accomplished by heating the sorbent tube and sweeping the desorbed compounds onto a secondary "cold" trap for water management and analyte refocusing. The secondary trap is heated for efficient transfer of compounds onto the gas chromatograph (GC) for separation followed by detection using mass spectrometry (MS).

Certain compounds are not included in Eurofins Air Toxics' standard target analyte list. These compounds are communicated at the time of client proposal request. Unless otherwise directed, the laboratory reports these non-standard compounds with partial validation. Validation includes a 3-point calibration with the lowest concentration defining the reporting limit, no second source verification is analyzed, and no method detection limit study is performed unless previous arrangements have been made. In addition, stability of the non-standard compound during sample storage, safe sampling volume, and desorption efficiency are not validated. Full validation may be available upon request.

The TO-17 method offers significant flexibility in its scope and application depending on the sorbent selected. The most commonly requested sorbent tubes and associated analytes are summarized in the QC tables below.

Table 1. Summary of Sorbent Applications

Sorbent	Typical Analyte Range	Water Management
Tenax TA	C7 – C26	Hydrophobic
Tenax GR	C7 – C30	Hydrophobic
Multi-bed "VI tube" (See TO-17 VI application)	C3 – C26	Largely Hydrophobic

Table 2. Method TO-17 VOCs (Tenax GR/TA) Reporting Limits and QC Limits

Analytes	Reporting Limit (ng)	QC Acceptance Criteria		
		ICAL (%RSD)	LCS (% R)	CCV (%D)
1,1,1-Trichloroethane	5.0	30	70 – 130	30
1,1,1,2-Tetrachloroethane	5.0	30	70 – 130	30
1,1,2,2-Tetrachloroethane	5.0	30	70 – 130	30
1,1,2-Trichloroethane	5.0	30	70 – 130	30
1,1-Dichloropropene	5.0	30	70 – 130	30
1,2,3-Trichlorobenzene	5.0	30	70 – 130	30
1,2,3-Trichloropropane	5.0	30	70 – 130	30
1,2,4-Trichlorobenzene	5.0	30	70 – 130	30
1,2,4-Trimethylbenzene	5.0	30	70 – 130	30
1,2-Dibromo-3-chloropropane	5.0	30	70 – 130	30
1,2-Dichlorobenzene	5.0	30	70 – 130	30
1,2-Dichloroethane	5.0	30	70 – 130	30
1,2-Dichloropropane	5.0	30	70 – 130	30
1,3,5-Trimethylbenzene	5.0	30	70 – 130	30
1,3-Dichlorobenzene	5.0	30	70 – 130	30
1,3-Dichloropropane	5.0	30	70 – 130	30
1,4-Dichlorobenzene	5.0	30	70 – 130	30
2-Chlorotoluene	5.0	30	70 – 130	30
4-Chlorotoluene	5.0	30	70 – 130	30
Benzene	10	30	70 – 130	30
Bromobenzene	5.0	30	70 – 130	30
Bromodichloromethane	5.0	30	70 – 130	30
Bromoform	5.0	30	70 – 130	30
Butylbenzene	5.0	30	70 – 130	30
Carbon Tetrachloride	5.0	30	70 – 130	30
Chlorobenzene	5.0	30	70 – 130	30
Chloroform	5.0	30	70 – 130	30
cis-1,3-Dichloropropene	5.0	30	70 – 130	30
cis-1,4-Dichloro-2-butene	5.0	30	70 – 130	30
Cumene	5.0	30	70 – 130	30

Dibromochloromethane	5.0	30	70 – 130	30
Dibromomethane	5.0	30	70 – 130	30
Ethylbenzene	5.0	30	70 – 130	30
Ethylene Dibromide	5.0	30	70 – 130	30
Hexachlorobutadiene	5.0	30	70 – 130	30
Naphthalene	5.0	30	70 – 130	30
m,p-Xylene	10	30	70 – 130	30
o-Xylene	5.0	30	70 – 130	30
p-Cymene	5.0	30	70 – 130	30
Propylbenzene	5.0	30	70 – 130	30
sec-Butylbenzene	5.0	30	70 – 130	30
Styrene	5.0	30	70 – 130	30
tert-Butylbenzene	5.0	30	70 – 130	30
Tetrachloroethene	5.0	30	70 – 130	30
Toluene	5.0	30	70 – 130	30
trans-1,3-Dichloropropene	5.0	30	70 – 130	30
trans-1,4-Dichloro-2-butene	5.0	30	70 – 130	30
Trichloroethene	5.0	30	70 – 130	30

Note: Full list may not be appropriate, depending on sample volume requirements.

Table 3. Commonly requested TPH parameters (Tenax GR/TA)

TPH	Reporting Limit (ng)	ICAL (%RSD)	ICV (% R)	CCV (%D)	LCS (%R)
GRO (Gasoline Range)	1000	30	70 – 130	30	70 – 130
DRO (C10-C24 Diesel Range)	1000	30	70 – 130	30	70 – 130
Kerosene	1000	30	70 – 130	30	70 – 130
Mineral Spirits (C9-C12 range)	1000	30	70 – 130	30	70 – 130

Table 4. Internal Standard and Field Surrogate Recoveries

Internal Standards		
Analyte	**CCV IS % Recovery**	**Sample IS % Recovery**
Bromochloromethane	60 – 140	60 – 140
1,4-Difluorobenzene	60 – 140	60 – 140
Chlorobenzene-d5	60 – 140	60 – 140
Field Surrogates		
Analyte	**% Recovery**	
1,2-Dichloroethane-d4	50 – 150	
Toluene-d8	50 – 150	
Naphthalene-d8	50 – 150	

Table 5. TO-17 SVOCs (Tenax GR/TA)

Analytes	Reporting Limit (ng)	Acceptance Criteria		
		ICAL (%RSD)	LCS (% R)	CCV (%D)
Naphthalene	5.0	30	70 – 130	30
2-Methylnaphthalene	5.0	30	70 – 130	30
Acenaphthylene	5.0	30	70 – 130	30
Acenaphthene	5.0	30	70 – 130	30
Fluorene	5.0	30	70 – 130	30
Phenanthrene	5.0	30	70 – 130	30
Anthracene	5.0	30	70 – 130	30
Fluoranthene	5.0	30	70 – 130	30
Pyrene	10	30	70 – 130	30
Internal Standards				
Analyte	**CCV IS % Recovery**		**Sample IS % Recovery**	
Bromofluorobenzene	60 – 140		60 – 140	
Field Surrogates				
Analyte	**% Recovery**			
Naphthalene-d8	50 – 150			

Table 5. Summary of Calibration and QC Procedures for TO-17 General Application

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
BFB Tune Check	Every 24 hours	TO-15 tune criteria	Correct problem then repeat tune.
5-Point Calibration	Prior to sample analysis	%RSD ≤ 30%, 2 allowed out up to 40%	Correct problem then repeat Initial Calibration Curve.
LCS	After each initial Calibration Curve and daily prior to analysis	Recovery 70 – 130%	If more than 5% target compounds exceed criteria, evaluate system and reanalyze the standard. Re-prepare the standard if necessary. Re-calibrate the instrument if the criteria cannot be met.
LCSD	Each analytical batch	Recovery 70 – 130%; %RPD ≤ 25%	If more than 5% target compounds exceed criteria, evaluate system and recollection process. Correct problem and reanalyze.
Continuing Calibration Verification (CCV)	At the start of each analytical clock	70 – 130 %	If project-specified risk drivers exceed these criteria, more than 5% of the compounds exceed these criteria, or any VOC exceeds 50–150% recovery, maintenance is performed and the CCV test repeated. If the system still fails the CCV, perform a new 5-point Calibration Curve.
Laboratory Blank	After the CCV and at the end of the analytical batch	Results less than the laboratory RL	Inspect the system and re-analyze the Blank. No corrective action for Lab Blank at end of batch.
Internal Standard (IS)	As each standard, Blank, and sample is being loaded	**CCVs:** area counts 60–140%, RT w/in 20 sec of mid-point in ICAL **Blanks and samples**: Retention time (RT) must be within ±0.33 minutes of the RT in the CCV. The IS area must be within ±40% of the CCV's IS area for the Blanks and samples.	**CCV:** Inspect and correct system prior to sample analysis. **Blanks:** Inspect the system and re-analyze the Blank. **Samples:** Samples cannot be re-analyzed due to the nature of the sorbent cartridges. However investigate the problem by reviewing the data. If necessary, run a Lab Blank to check the instrument performance. Report the data and narrate.

Field Surrogates	Each clean sample tube used for pumped sample collection and lab blank and QC samples	50 – 150%	**For blanks:** Inspect the system and re-analyze the Blank. **For samples:** If no obvious reason can be ascertained after evaluation of the data and sample collection parameters, the sample should be reanalyzed to verify out of control recovery. If recovery is out of acceptance criteria in both the primary and recollected sample, the primary sample is reported with the surrogate flagged.

ANALYTICAL METHODS

Section 2.0

Method: EPA Method TO-14A/TO-15 Volatile Organic Compounds (Standard/Quad)

Eurofins Air Toxics SOP #6 Revision 30 Effective Date: April 30, 2013 Methods Manual Summary

Description: This method involves full scan gas chromatograph/mass spectrometer (GC/MS) analysis of whole air samples collected in evacuated stainless steel canisters. Samples are analyzed for volatile organic compounds (VOCs) using EPA Method TO-14A/TO-15 protocols. An aliquot of up to 0.5 liters of air is withdrawn from the canister utilizing a volumetric syringe, volumetric loop, or mass flow controller. This volume is loaded onto a hydrophobic multibed sorbent trap to remove water and carbon dioxide and to concentrate the vapor sample. The focused sample is then flash-heated to sweep adsorbed VOCs onto a secondary trap for further concentration and/or directly onto a GC/MS for separation and detection.

Eurofins Air Toxics maintains a suite of TO-14A/TO-15 methods, each optimized to efficiently meet the data objectives for a wide range of targeted concentration ranges. The methods, their reporting limits, and typical applications are summarized in the table below. This method summary describes TO-14A/TO-15 (Standard or Quad).

Eurofins Air Toxics Method	Base Reporting Limits	Typical Application
TO-14A/TO-15 (5&20)	5 – 20 ppbv	Soil gas and ppmv range vapor matrices
⇨ TO-14A/TO-15 (Standard or Quad)	0.5 – 5.0 ppbv	Ambient air, soil gas, and ppbv level vapor matrices
TO-14A/TO-15 (Low-level)	0.1 – 0.5 ppbv	Indoor and outdoor air
TO-14A/TO-15 SIM	0.003 – 0.5 ppbv	Indoor and outdoor air

Certain compounds are not included in Eurofins Air Toxics' standard target analyte list. These compounds are communicated at the time of client proposal request. Unless otherwise directed, Eurofins Air Toxics reports these non-routine compounds with partial validation. Validation may include a 3-point calibration with the lowest concentration defining the reporting limit, no second source verification analyzed, and no method detection limit study performed unless previous arrangements have been made. In addition, stability of the non-standard compound during sample storage is not validated. Full validation may be available upon request.

Eurofins Air Toxics takes no modifications of technical significance to Method TO-15 for the "Quad" configurations. Since Eurofins Air Toxics applies TO-15 methodology to all Summa canisters regardless of whether TO-14A or TO-15 is specified by the project, the laboratory performs a modified version of method TO-14A as detailed in Table 1. Please note that Methods TO-14A and TO-15 were validated for specially treated canisters. As such, the use of Tedlar bags for sample collection is outside the scope of the method and not recommended for ambient or indoor air samples. It is the responsibility of the data user to determine the usability of TO-14A and TO-15 results generated from Tedlar bags.

Table 1. Summary of TO-14A Method Modifications

Requirement	TO-14A	Eurofins Air Toxics Modifications
Sample Drying System	Nafion Drier	Multibed hydrophobic sorbent
Blank acceptance criteria	≤ 0.2 ppbv	≤ RL
BFB ion abundance criteria	Ion abundance criteria listed in Table 4 of TO-14A	Follow abundance criteria listed in TO-15.
BFB absolute abundance criteria	Within 10% when comparing to the previous daily BFB	CCV internal standard area counts are compared to ICAL; corrective action when recovery is less than 60%.
Initial Calibration	≤ 30% RSD for listed 39 VOCs	≤ 30% RSD with 2 of Eurofins Air Toxics' 62 standard compounds allowed out to ≤ 40% RSD

The standard target analyte list, reporting limit (RL) also referred to as Limit of Quantitation, QC criteria, and QC summary can be found in Tables 2 through 5.

Table 2. Method TO-14A/TO-15 Analyte List (Quad)

Analyte	RL/LOQ (ppbv)	QC Acceptance Criteria			
		ICAL (%RSD)	CCV (%R)	ICV/LCS (%R)	Precision Limits (Max. RPD)
1,1,2,2-Tetrachloroethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,1,2-Trichloroethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,1-Dichloroethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,1-Dichloroethene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,2,4-Trichlorobenzene	2.0	≤ 30%	70 – 130	70 – 130	± 25
1,2,4-Trimethylbenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dibromoethane (EDB)	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dichlorobenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dichloroethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dichloropropane	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,3,5-Trimethylbenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,3-Dichlorobenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,4-Dichlorobenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Benzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Bromomethane*	5.0	≤ 30%	70 – 130	70 – 130	± 25
Carbon Tetrachloride	0.5	≤ 30%	70 – 130	70 – 130	± 25
Chlorobenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25

Chloroethane	2.0	≤ 30%	70 – 130	70 – 130	± 25
Chloroform	0.5	≤ 30%	70 – 130	70 – 130	± 25
Chloromethane	5.0	≤ 30%	70 – 130	70 – 130	± 25
Chlorotoluene (Benzyl Chloride)	0.5	≤ 30%	70 – 130	70 – 130	± 25
cis-1,2-Dichloroethene	0.5	≤ 30%	70 – 130	70 – 130	± 25
cis-1,3-Dichloropropene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Dichloromethane (Methylene Chloride)	5.0	≤ 30%	70 – 130	70 – 130	± 25
Ethylbenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Freon 11 (Trichlorofluoromethane)	0.5	≤ 30%	70 – 130	70 – 130	± 25
Freon 113 (Trichlorotrifluoroethane)	0.5	≤ 30%	70 – 130	70 – 130	± 25
Freon 114	0.5	≤ 30%	70 – 130	70 – 130	± 25
Freon 12 (Dichlorodifluoromethane)	0.5	≤ 30%	70 – 130	70 – 130	± 25
Hexachlorobutadiene	2.0	≤ 30%	70 – 130	70 – 130	± 25
m,p-Xylene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Methyl Chloroform (1,1,1-Trichloroethane)	0.5	≤ 30%	70 – 130	70 – 130	± 25
o-Xylene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Styrene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Tetrachloroethene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Toluene	0.5	≤ 30%	70 – 130	70 – 130	± 25
trans-1,3-Dichloropropene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Trichloroethene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Vinyl Chloride	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,3-Butadiene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,4-Dioxane	2.0	≤ 30%	70 – 130	70 – 130	± 25
2-Butanone (Methyl Ethyl Ketone)	2.0	≤ 30%	70 – 130	70 – 130	± 25
2-Hexanone	2.0	≤ 30%	70 – 130	70 – 130	± 25
4-Ethyltoluene	0.5	≤ 30%	70 – 130	70 – 130	± 25
4-Methyl-2-Pentanone (MIBK)	0.5	≤ 30%	70 – 130	70 – 130	± 25
Acetone	5.0	≤ 30%	70 – 130	70 – 130	± 25
Bromodichloromethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Bromoform	0.5	≤ 30%	70 – 130	70 – 130	± 25
Carbon Disulfide	2.0	≤ 30%	70 – 130	70 – 130	± 25
Cyclohexane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Dibromochloromethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Ethanol	2.0	≤ 30%	70 – 130	70 – 130	± 25

Heptane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Hexane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Isopropanol	2.0	≤ 30%	70 – 130	70 – 130	± 25
Methyl t-Butyl Ether (MTBE)	0.5	≤ 30%	70 – 130	70 – 130	± 25
Tetrahydrofuran	0.5	≤ 30%	70 – 130	70 – 130	± 25
trans-1,2-Dichloroethene	0.5	≤ 30%	70 – 130	70 – 130	± 25
2,2,4-Trimethylpentane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Cumene	0.5	≤ 30%	70 – 130	70 – 130	± 25
Propylbenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
3-Chloroprene	2.0	≤ 30%	70 – 130	70 – 130	± 25
Naphthalene**	2.0	≤40%	60 – 140	60 – 140	± 25
TPH (Gasoline) ***	25	1-Point Calibration	N/A	ICV only; 60 – 140	± 25
NMOC (Hexane/Heptane)***	10	1-Point Calibration	N/A	NA	± 25

*****Bromomethane recovery can be variable due to moisture/sorbent interactions specifically on the 2-trap concentration system. Data may require qualifier flags.

**Due to its low vapor pressure, Naphthalene may exceed TO-15 performance requirements. The wider QC limits reflect typical performance. Although Naphthalene is not on Eurofins Air Toxics "standard" TO-15 list, it is commonly requested and included in Table 2.

***TPH and NMOC are not on Eurofins Air Toxics' "standard" TO-15 list, but are included in Table 2 due to common requests.

Table 3. Internal Standards

Analyte	Accuracy (% R)
Bromochloromethane	60 – 140
1,4-Difluorobenzene	60 – 140
Chlorobenzene-d_5	60 – 140

Table 4. Surrogates

Analyte	Accuracy (% R)
1,2-Dichloroethane-d_4	70 – 130
Toluene-d_8	70 – 130
4-Bromofluorobenzene	70 – 130

Table 5. Summary of Calibration and QC Procedures for Methods TO-14A/TO-15

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Every 24 hours	TO-15 ion abundance criteria	Correct problem then repeat tune.
Minimum 5-Point Initial Calibration (ICAL)	Prior to sample analysis	% RSD ≤ 30 with 2 compounds allowed out to ≤ 40% RSD	Correct problem then repeat Initial Calibration curve.
Initial Calibration Verification and Laboratory Control Spike (ICV and LCS)	After each Initial Calibration curve, and daily prior to sample analysis	Recoveries for 85% of "Standard" compounds must be 70–130%. No recovery may be < 50%. If specified by the client, in-house generated control limits may be used.	Check the system and reanalyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.
Initial Calibration Verification and Laboratory Control Spike (ICV and LCS) for Non-standard compounds	Per client request or specific project requirements only	Recoveries of compounds must be 60–140%. No recovery may be <50%.	Check the system and reanalyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.
Continuing Calibration Verification (CCV) for Standard compounds	At the start of each analytical clock after the tune check	70–130%	Compounds exceeding this criterion and associated data will be flagged and narrated with the exception of high bias associated with non-detects. If more than two compounds from the standard list recover outside of 70–130%, corrective action will be taken. If any compound exceeds 60–140%, samples are not analyzed unless data meets project needs. Check the system and reanalyze the standard. Re-prepare the standard if necessary. Re-calibrate the instrument if the criteria cannot be met.
Continuing Calibration Verification (CCV) for Non-standard Compounds	Per client request or specific project requirements only.	Recoveries of compounds must be 60–140%. No recovery may be <50%.	Check the system and reanalyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.
Laboratory Blank	After analysis of standards and prior to sample analysis, or when contamination is present.	Results less than the laboratory reporting limit	Inspect the system and re-analyze the blank. "B"-flag data for common contaminants.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Internal Standard (IS)	As each standard, blank, and sample is being loaded	Retention time (RT) for blanks and samples must be within ±0.33 min of the RT in the CCV and within ±40% of the area counts of the daily CCV internal standards.	**For blanks:** Inspect the system and reanalyze the blank. **For samples:** Re-analyze the sample. If the ISs are within limits in the re-analysis, report the second analysis. If ISs are out-of-limits a second time, dilute the sample until ISs are within acceptance limits and narrate.
Surrogates	As each standard, blank, and sample is being loaded	70–130% If specified by the client, in-house generated control limits may be used.	**For blanks:** Inspect the system and reanalyze the blank. **For samples:** Re-analyze the sample unless obvious matrix interference is documented. If the %Rs are within limits in the re-analysis, report the second analysis. If %Rs are out-of-limits a second time, report data from first analysis and narrate.
Laboratory Duplicates – Laboratory Control Spike Duplicates (LCSD)	One per analytical batch	RPD ≤25%	Narrate exceedances. If more than 5% of compound list is outside criteria or if compound has >40%RPD, investigate the cause and perform maintenance as required. If instrument maintenance is required, calibrate as needed.

ANALYTICAL METHODS

Section 3.0

Method: ASTM D1946 – Atmospheric Gases

Eurofins Air Toxics SOP #8 Revision 22 Effective Date: December 24, 2013 Methods Manual Summary

Description: This method involves gas chromatograph (GC) analysis of soil gas, landfill gas, ambient air, or stack gas collected in Summa™ canisters, Tedlar bags, or any vessel that has been demonstrated to be clean and leak free. Samples are analyzed for Methane, fixed gases, and Non-Methane Organic Carbon (NMOC) using modified ASTM D1946 protocols. Because the sample is withdrawn from the vessel by positive pressure, rigid containers are first filled to positive pressure using UHP Helium or Nitrogen. Samples are then analyzed using a GC equipped with a FID and a TCD.

Certain compounds are not included in Eurofins Air Toxics' standard target analyte list. These compounds are communicated at the time of client proposal request. Unless otherwise directed, the laboratory reports these non-standard compounds with partial validation. Validation includes a 3-point calibration with the lowest concentration defining the reporting limit, no second source verification is analyzed, and no method detection limit study is performed unless previous arrangements have been made. In addition, stability of the non-standard compound during sample storage is not validated. Full validation may be available upon request.

Since the protocols in the ASTM D1946 standard were designed for the analysis of reformed gas, the laboratory has taken modifications to apply the method to environmental samples covering a wide concentration range and to implement standard NELAP and EPA calibration criteria. The method modifications, standard target analyte list, reporting limits (RL), Quality Control (QC) criteria, and QC summary can be found in the following tables.

Table 1. Summary of Method Modifications for ASTM D1946

Requirement	ASTM D1946	Eurofins Air Toxics Modifications
Calibration	A single-point calibration is performed using a reference standard closely matching the composition of the unknown.	A minimum 3-point calibration curve is performed. Quantitation is based on a daily calibration standard, which may or may not resemble the composition of the associated samples.
Reference Standard	The composition of any reference standard must be known to within 0.01 mol % for any component.	The standards used by Eurofins Air Toxics are blended to a ≥ 95% accuracy.
Sample Injection Volume	Components whose concentrations are in excess of 5% should not be analyzed by using sample volumes greater than 0.5 mL.	The sample container is connected directly to a fixed volume sample loop of 1.0 mL. Linear range is defined by the calibration curve. Bags may be loaded by vacuum or by positive pressure.
Normalization	Normalize the mole percent values by multiplying each value by 100 and dividing by the sum of the original values. The sum of the original values should not differ from 100% by more than 1.0%.	Results are not normalized. The sum of the reported values can differ from 100% by as much as 15%, either due to analytical variability or an unusual sample matrix.

Precision	Precision requirements established at each concentration level.	Duplicates should agree within 25% RPD for detections >5X the RL.

Table 2. ASTM D1946 Method Compound List and QC Limits

Compound	Reporting Limit (%)	ICAL Criteria (%RSD)	ICV/LCS Criteria (%R)	CCV Criteria (%D)	Precision Limits (RPD)**
Carbon Dioxide	0.010	≤ 15%	85 – 115	± 15%	± 25%
Carbon Monoxide	0.010	≤ 15%	85 – 115	± 15%	± 25%
Methane	0.00010	≤ 15%	85 – 115	± 15%	± 25%
Ethene	0.0010	≤ 15%	85 – 115	± 15%	± 25%
Ethane	0.0010	≤ 15%	85 – 115	± 15%	± 25%
Nitrogen	0.10	≤ 15%	85 – 115	± 15%	± 25%
NMOC	0.010	≤ 15%	85 – 115	± 15%	± 25%
Oxygen	0.10	≤ 15%	85 – 115	± 15%	± 25%
Helium	0.050	≤ 15%	85 – 115	± 15%	± 25%
Hydrogen	0.010*	≤ 15%	85 – 115	± 15%	± 25%

*Reporting limit is 1.0% when sample is pressurized with Helium.
**For detections greater than 5 times the reporting limit.

Note: Results are reported in units of mol %. If required to report volume % or ppmV, a compressibility factor of 1 for all gases will be assumed. As a result, mol % is assumed to be equivalent to volume %. This assumption may result in a bias for highly compressible gases at high concentrations and pressures.

Table 3. Summary of Calibration and QC Procedures for Mod. ASTM Method D1946

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Initial Calibration Curve (ICAL)	Prior to sample analysis	RSD ≤ 15%	Correct problem then repeat Initial Calibration.
Second Source Verification (LCS)	All analytes: once per Initial Calibration, and with each analytical batch.	%R between 85–115%	Check the system and re-analyze the standard. Re-calibrate the instrument if the criteria cannot be met.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis and after every 20 reportable samples.	%D ±15%	Check the system and re-analyze the standard. Re-calibrate the instrument if the criteria cannot be met.
Laboratory Blank (He) (N_2 for He and H_2 analysis)	After each daily check standard and prior to sample analysis, or when contamination is present.	Results below the RL	Inspect the system and re-analyze the Blank.
End Check	At the end of analytical sequence. It can be primary (CCV) or Independent Source (LCS).	%R between 85–115%	Check system and re-analyze the standard. If the 2nd analysis fails, identify and correct the problem. Samples analyzed after the last acceptable CCV are re-analyzed.
Sample Duplicates - Laboratory Control Spike Duplicate (LCSD)	One per analytical batch	RPD ≤ 25%	Narrate exceedances. Investigate the cause and perform maintenance as required and re-calibrate as needed.

ANALYTICAL METHODS

Section 4.0

Method: EPA Method TO-13A PAHs (Full Scan and SIM)

Eurofins Air Toxics SOP #10	Revision 18	Effective Date: April 26, 2013	Methods Manual Summary
Eurofins Air Toxics SOP #74	Revision 10	Effective Date: January 14, 2013	Methods Manual Summary

Description: This method involves drawing a measured volume of air through a filter and sorbent cartridge to collect Polychlorinated Biphenyls (PAHs) in the vapor and particulate phases. The cartridge can be PUF/XAD2 or XAD2 only. While TO-13A describes the use of a high-volume sampling pump, which allows for up to 300 cubic meters (m^3) of air to be collected over a 24-hour period, the method can also be applied to low-volume sample applications suitable for indoor air or soil gas. The sample media is extracted in the laboratory using Soxhlet extraction or pressurized fluid extraction (PFE). The concentrated extracts are analyzed for PAHs using a quadrupole gas chromatograph/mass spectrometer (GC/MS) in full scan or SIM mode by TO-13A protocol. Eurofins Air Toxics performs a modified version of this method. The method modifications, standard target analyte list, Limit of Quantitation (LOQ), QC criteria, and QC summary can be found in the following tables.

In relation to the prescribed media, sampling and collection efficiencies for compounds not listed in TO-13A have not been evaluated. However, if non-standard compounds are required for a project, the laboratory reports these compounds with partial validation. Validation includes a 3-point calibration with the lowest concentration defining the reporting limit, no second source verification is analyzed, and no method detection limit study is performed unless previous arrangements have been made. In addition, stability of the non-standard compound during sample storage is not validated. Full validation may be available upon request.

Required Field QC: EPA Method TO-13 requires at least one field blank per sampling episode. Matrix spikes are referenced, but not definitively required in the routine QA specifications.

Table 1. Summary of Method Modifications for TO-13A

Requirements	EPA Method TO-13A	Eurofins Air Toxics Modifications
Extraction Solvent	10% ether in hexane for PUF; DCM for XAD sorbent. Final extract in hexane.	DCM for PUF/XAD cartridge and XAD sorbent. Final extract in DCM.
Glassware Cleaning	Muffle furnace is utilized.	Solvent cleaning procedure is used.
Extraction Technique	Soxhlet extraction	Soxhlet extraction or pressurized fluid extraction (PFE)
Reporting List	19 PAHs	See Table 2
Calibration range	0.1–2.5 µg/mL in hexane	1.0–160 µg/mL in methylene chloride for standard (quad) or 0.1–40 µg/mL for SIM
Method Blank	< MDL	< Reporting Limit

Table 2. Modified Method TO-13A Analyte List and Reporting Limits

Analyte	SIM RL (µg)	RL (µg)	Minimum ICAL RRF	ICAL (%RSD)	ICV (%R)	CCV (%R)	Precision (%RPD)
2-Chloronaphthalene*	0.1	1.0	NA	≤ 30	± 30	± 30	≤ 25%
2-Methylnaphthalene*	0.1	1.0	NA	≤ 30	± 30	± 30	≤ 25%
Acenaphthylene	0.1	1.0	1.3	≤ 30	± 30	± 30	≤ 25%
Acenaphthene	0.1	1.0	0.8	≤ 30	± 30	± 30	≤ 25%
Anthracene	0.1	1.0	0.7	≤ 30	± 30	± 30	≤ 25%
Benzo(a)anthracene	0.1	1.0	0.8	≤ 30	± 30	± 30	≤ 25%
Benzo(e)pyrene*	0.1	1.0	NA	≤ 30	± 30	± 30	≤ 25%
Benzo(a)pyrene	0.1	1.0	0.7	≤ 30	± 30	± 30	≤ 25%
Benzo(b)fluoranthene	0.1	1.0	0.7	≤ 30	± 30	± 30	≤ 25%
Benzo(g,h,i)perylene	0.1	1.0	0.5	≤ 30	± 30	± 30	≤ 25%
Benzo(k)fluoranthene	0.1	1.0	0.7	≤ 30	± 30	± 30	≤ 25%
Chrysene	0.1	1.0	0.7	≤ 30	± 30	± 30	≤ 25%
Dibenz(a,h)anthracene	0.1	1.0	0.4	≤ 30	± 30	± 30	≤ 25%
Fluoranthene	0.1	1.0	0.6	≤ 30	± 30	± 30	≤ 25%
Fluorene	0.1	1.0	0.9	≤ 30	± 30	± 30	≤ 25%
Indeno(1,2,3-c,d)pyrene	0.1	1.0	0.5	≤ 30	± 30	± 30	≤ 25%
Naphthalene	0.1	1.0	0.7	≤ 30	± 30	± 30	≤ 25%
Phenanthrene	0.1	1.0	0.7	≤ 30	± 30	± 30	≤ 25%
Pyrene	0.1	1.0	0.6	≤ 30	± 30	± 30	≤ 25%

* Not included in the TO-13A method.

The following two compounds can be analyzed upon client request:

Analyte	SIM RL (µg)	RL (µg)	Minimum ICAL RRF	ICAL (%RSD)	ICV (%R)	CCV (%R)	Precision (%RPD)
Perylene	N/A	1.0	0.5	≤ 30	± 30	± 30	≤ 25%
Coronene	N/A	1.0	0.7	≤ 30	± 30	± 30	≤ 25%

Table 3. Surrogates

Field Surrogates	Accuracy (%R)
Fluoranthene-d_{10}	50 – 150
Benzo(a)pyrene-d_{12}	50 – 150

Extraction Surrogates	Accuracy (%R)*
Fluorene-d_{10}	60 – 120
Pyrene-d_{10}	60 – 120

Table 4. Internal Standards

Analyte	Accuracy (%R)
Acenaphthene-d_{10}	-50 to +100
Chrysene-d_{12}	-50 to +100
1,4-Dichlorobenzene-d_4	-50 to +100
Naphthalene-d_8	-50 to +100
Perylene-d_{12}	-50 to +100
Phenanthrene-d_{10}	-50 to +100

Table 5. Extracted Laboratory Control Samples for TO-13A (PAHs) in Full Scan and SIM

Analyte	(%R)*
Naphthalene	60 – 120
Acenapthylene	60 – 120
Acenaphthene	60 – 120
Fluorene	60 – 120
Phenanthrene	60 – 120
Anthracene	60 – 120
Fluoranthene	60 – 120
Pyrene	60 – 120
Benzo(a)anthracene	60 – 120
Chrysene	60 – 120
Benzo(b)fluoranthene	60 – 120
Benzo(k)fluoranthene	60 – 120
Benzo(a)pyrene	60 – 120
Indeno(1,2,3-cd)pyrene	60 – 120
Dibenzo(a,h)anthracene	60 – 120
Benzo(g,h,i)perylene	60 – 120
2-Methylnaphthalene	60 - 120
2-Chloronaphthalene	60 – 120

*The LCS and Surrogate limits are derived from Compendium Method TO-13A, Sections 13.3.7.4 and 13.4.6.3 (January 1999). These limits only apply to samples that are extracted by Eurofins Air Toxics. When sample extracts are sent to the lab for analysis only, limits of 50-150 % are applied.

Table 6. Summary of Calibration and QC Procedures for EPA Method TO-13A

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Prior to calibration and at start of every 12 hours	TO-13A tuning criteria	Correct problem then repeat tune.
Initial 5-Point Calibration	Prior to sample analysis	ICAL criteria in Table 2	Correct problem then repeat initial calibration.
ICAL ICV	All analytes: Once per initial calibration	All target compound recoveries must be between 70 – 130%	Determine the source of discrepancy between standards. Re-calibrate if needed.
Continuing Calibration Verification (CCV)	At the start of every clock immediately after the DFTPP tune check	PAHs list: Meet Table 2 Min. RRF requirement; %D ≤ 30%	Investigate and correct the problem, up to and including re-calibration if necessary. High bias associated with non-detects in samples will not result in re-analysis.
Internal Standards (IS)	Injected into each standard, blank, and sample extract prior to analysis	**For CCV:** Area count within 50% to 200% of the midpoint of ICAL. **For blanks, samples, and non-CCV QC checks:** retention times within ± 0.33 minutes (20 seconds) and area counts within 50% to 200% of the CCV.	**For CCVs:** Investigate and correct the problem before proceeding with sample analysis. **For blanks:** Inspect the system and re-analyze the blank. **For samples and non-CCV QC:** Unless there is obvious matrix effect, re-analyze the samples and dilute the sample until the ISs meet the criteria; narrate the data to indicate interference.
Surrogates	Field Surrogates: Blank cartridges prior to transport to field for sampling and lab QC prior to extraction. Extraction Surrogates: All samples and lab QC prior to extraction.	See Table 3.	A new aliquot of the extract is analyzed. If Surrogate recoveries are out-of-control a second time, data is flagged and narrated. Re-analysis is not necessary for obvious matrix effects (data is flagged for out-of-control surrogate recoveries). Air samples cannot be re-extracted.
Extracted Laboratory Control Samples (LCS)	With each set of up to 20 extracted samples	See LCS criteria in Table 5.	Re-aliquot and re-analyze the extract. If within limits, report the re-analysis. Otherwise, narrate.

Laboratory Blank	With each set of up to 20 extracted samples	Results less than laboratory reporting limit (Table 2).	Re-aliquot and re-analyze the extract. If less than reporting limit, report the re-analysis. Otherwise, narrate and flag the data.
Solvent Blank	When samples that are extracted together are analyzed on different analytical shifts	All target compounds below the reporting limit (Table 2).	Re-aliquot and re-analyze the solvent. If less than reporting limit, report the re-analysis. Identify the source of contamination, and perform maintenance as needed. If maintenance required, restart the analytical clock.
Laboratory Duplicates – Laboratory Control Spike Duplicates	One per analytical batch	RPD ≤ 25%	Re-analyze duplicate. Investigate the cause, perform maintenance as required, and re-calibrate as needed.

ANALYTICAL METHODS

Section 5.0

Method: Modified EPA Method TO-11A Aldehydes/Ketones

Eurofins Air Toxics SOP #11 Revision 17 Effective Date: March 4, 2014 Methods Manual Summary

Description: This method involves high-pressure liquid chromatography (HPLC) analysis of aldehydes and ketones in ambient air samples. The sampling media is a 2,4-Dinitrophenylhydrazine (DNPH)-coated (silica) cartridge. Aldehydes and ketones are readily converted to a stable hydrazone derivative. The DNPH cartridges are eluted with acetonitrile using gravity-feed technique. Analysis is performed by reverse phase HPLC with UV detection at 360 nm.

Certain compounds are not included in Eurofins Air Toxics' standard target analyte list. These compounds are communicated at the time of client proposal request. Unless otherwise directed, Eurofins Air Toxics reports these non-standard compounds with partial validation. Validation includes a 3-point calibration with the lowest concentration defining the reporting limit, no second source verification is analyzed, and no method detection limit study is performed unless previous arrangements have been made. For the extraction process, the non-standard compound recovery is evaluated in the extracted laboratory control spike. In addition, stability of the non-standard compound during sample storage is not validated. Full validation may be available upon request.

Eurofins Air Toxics performs modified versions of this method. The method modifications, standard target analyte list, Limits of Quantitation (LOQs), reporting limits (RLs), Quality Control (QC) criteria, and QC summary can be found in the following tables.

Table 1. Summary of Method TO-11A Modifications

Requirement	TO-11A	Eurofins Air Toxics Modifications
Initial Calibration Curve (ICAL)	Multi-point using linear regression performed every 6 months	Multi-point using average Response Factor; re-calibration if daily calibration fails, major maintenance, or column change. Linear regression is performed when requested. Initial Calibration (ICAL) is performed at least once per year.
ICAL Criteria	R^2 for curve ≥ 0.999	%RSD $\leq$ 10% unless linear regression is required, with R^2 for curve ≥ 0.999
Blank Subtraction	Average blank concentrations calculated. Blank value subtracted from sample result.	One Lab Blank is analyzed per batch; no automatic blank subtraction performed on samples.
Retention Times	Precision of Retention Times ±7%	Retention Time window study is performed, but RT windows are determined by bracketing standards.

Table 2. Method TO-11A Analyte List and QC Criteria (Environmental Field Samples)

Analyte	TO-11A LOQ/RL[a] (µg)	ICAL (%RSD)	ISCV (%R)	CCV (%R)
Acetaldehyde	0.10	≤ 10	± 15	± 10
Acrolein[b]	0.25[d]	≤ 10	± 15	± 10
Benzaldehyde	0.25	≤ 10	± 15	± 10
Crotonaldehyde	0.25	≤ 10	± 15	± 10
Formaldehyde	0.05	≤ 10	± 15	± 10
Hexanal	0.25	≤ 10	± 15	± 10
Isopentanal	0.25	≤ 10	± 15	± 10
MEK/Butyraldehydes[c]	0.25	≤ 10	± 15	± 10
m,p-Tolualdehyde	0.25	≤ 10	± 15	± 10
o-Tolualdehyde	0.25	≤ 10	± 15	± 10
Pentanal	0.25	≤ 10	± 15	± 10
Propanal	0.25	≤ 10	± 15	± 10
Acetone	0.25	≤ 10	± 15	± 10
Acetophenone*	N/A	≤ 10	± 15	± 10
Isophorone*	N/A	≤ 10	± 15	± 10
Heptaldehyde*	0.25	≤ 10	± 15	± 10
2,5-Dimethylbenzaldehyde*	0.25	≤ 10	± 15	± 10

[a] Noted reporting limits are subject to change based on most current MDL study.

[b] Because its derivative is not stable, when the target analyte list includes Acrolein the sample will need to be extracted in field. A special order should be placed with the laboratory during the project set-up stage.

[c] Methyl Ethyl Ketone and the Butyraldehydes co-elute.

[d] Not recommended.

* Special compounds upon request only.

Table 3. Summary of Calibration and QC Procedures for Method TO-11A

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
5-Point Initial Calibration Curve (ICAL)	Analyzed in triplicate prior to sample analysis	%RSD ≤ 10	Repeat calibration.
Instrument LCS	With each ICAL	%R = 85–115%	Check the system and re-analyze the standard. Re-calibrate the instrument if the criteria cannot be met.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis, after a maximum of every 10 injections, and at the end of the analytical batch	Within ±10% of the expected value	Check the system and re-analyze the standard. If the criteria cannot be met, re-calibrate the instrument. If the standard is biased low, re-analyze all samples since last acceptable CCV. If biased high and samples are "ND", re-analysis is not required. "Q"-flag high recoveries.
Instrument (Solvent) Blank Analysis	Following analysis of Standards	Results less than the laboratory RL	Inspect the system and re-analyze the blank.
Laboratory Duplicates - Laboratory Control Spike Duplicate	One per analytical batch	RPD ≤ 25%	Re-analyze the sample a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found with the system, narrate the data.

ANALYTICAL METHODS

Section 6.0

Method: ASTM D5504 – Sulfur Compounds

Eurofins Air Toxics SOP #13 Revision 17 Effective Date: December 27, 2013 Methods Manual Summary

Description: This method involves gas chromatograph (GC) analysis of whole air samples for sulfur compounds collected in Tedlar bags. Detection of volatile sulfur compounds is accomplished using a Sulfur Chemiluminescence Detector (SCD) following method ASTM D5504.

Care should be taken to ensure samples to be analyzed for reduced sulfur compounds do not come into contact with any metal surfaces. In addition, because of the reactivity of Hydrogen Sulfide (H_2S), and mercaptans, samples collected in Tedlar bags should be analyzed within 24 hours of collection. Samples collected in Tedlar bags should also be protected from heat and light.

Certain compounds are not included in Eurofins Air Toxics' standard target analyte list. These compounds are communicated at the time of client proposal request. Unless otherwise directed, the laboratory reports these non-standard compounds with partial validation. Validation includes a 3-point calibration with the lowest concentration defining the reporting limit, no second source verification is analyzed, and no method detection limit study is performed unless previous arrangements have been made. In addition, stability of the non-standard compound during sample storage is not validated. Full validation may be available upon request.

The laboratory is not equipped to handle >100 ppmv levels of sulfur compounds. Please notify the laboratory if ppmv levels of sulfur compounds are anticipated.

Method Modifications: The Quality Control (QC) elements listed in the latest ASTM Method D5504-01 are suggested, *not required*. In general, calibration protocols followed by the laboratory are designed to meet standard NELAP and EPA environmental data acceptance criteria. Several method suggestions of note are not included in the laboratory QC procedures unless requested by the client. The deviations from the method recommendations are as follows:

- All field samples are not analyzed in duplicate.
- Daily spiked field samples are not analyzed.

Additionally, upon special request, Eurofins Air Toxics provides passivated canisters for sulfur collection. *Air Toxics does not examine passivated canisters for continued sulfur stability as required by the method, and previous studies have demonstrated that recoveries of the glass-lined canisters indicate a potential loss of inertness which can vary from canister to canister.* Sample analysis results derived from passivated canister media are reported with the appropriate narration. Per the ASTM D5504 method, the storage time when using a passivated/lined canister is not to exceed 7 days.

The standard target analyte list, reporting limits (RL), QC criteria, and QC summary can be found in the following tables.

Table 1. ASTM Method D5504 Compound List and QC Limits

Analyte	RL (ppbv)	QC Acceptance Criteria		
		ICAL (% RSD)	LCS/ CCV* (% R)	Precision (% RPD)
2,5-Dimethylthiophene	4.0	≤ 30	70 – 130	≤ 25
2-Ethylthiophene	4.0	≤ 30	70 –130	≤ 25
3-Methylthiophene	4.0	≤ 30	70 – 130	≤ 25
Carbon Disulfide	5.0	≤ 30	70 – 130	≤ 25
Carbonyl Sulfide	4.0	≤ 30	70 – 130	≤ 25
Diethyl Disulfide	4.0	≤ 30	70 – 130	≤ 25
Diethyl Sulfide	4.0	≤ 30	70 – 130	≤ 25
Dimethyl Disulfide	4.0	≤ 30	70 – 130	≤ 25
Dimethyl Sulfide	4.0	≤ 30	70 – 130	≤ 25
Ethyl Mercaptan	4.0	≤ 30	70 – 130	≤ 25
Ethyl Methyl Sulfide	4.0	≤ 30	70 – 130	≤ 25
Hydrogen Sulfide	4.0	≤ 30	70 – 130	≤ 25
Isobutyl Mercaptan	4.0	≤ 30	70 – 130	≤ 25
Isopropyl Mercaptan	4.0	≤ 30	70 – 130	≤ 25
Methyl Mercaptan	4.0	≤ 30	70 – 130	≤ 25
n-Butyl Mercaptan	4.0	≤ 30	70 – 130	≤ 25
n-Propyl Mercaptan	4.0	≤ 30	70 – 130	≤ 25
tert-Butyl Mercaptan	4.0	≤ 30	70 – 130	≤ 25
Tetrahydrothiophene	4.0	≤ 30	70 – 130	≤ 25
Thiophene	4.0	≤ 30	70 – 130	≤ 25

*The recovery for all analytes should be 70-130%; end check recoveries are 70-130% with 2 allowed out up to 60-140%. The recovery for Hydrogen Sulfide, Carbonyl Sulfide and Carbon Disulfide must be 70-130%.

Table 2. Summary of Calibration and QC Procedures for ASTM Method D 5504

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Initial Calibration (ICAL)	Prior to sample analysis	A minimum of 5 points (3 points may be accepted to meet sample hold times.) % RSD ≤ 30	Evaluate system. Re-prepare and/or re-analyze calibration points.
Second Source Verification (LCS)	With each Initial Calibration; with each analytical batch.	70–130% of the expected values for all the compounds	Check the system, re-prepare and/or re-analyze standard. Re-calibrate instrument if CCV shows similar recoveries. If recoveries are high and no detections are expected, sample analysis may proceed. If hold-time is at risk, flagging and narration of non-compliant compounds may be appropriate.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis	%Recovery = 70–130%	Check the system, re-prepare and re-analyze standard. Re-calibrate instrument if re-analysis shows similar recoveries. If recoveries are high and no detections are expected, sample analysis may proceed. If hold-time is at risk, flagging and narration of non-compliant may be appropriate.
Laboratory Blank	After daily LCS and after high level samples and mid-check standards as needed	Results less than the laboratory reporting limit.	Inspect the system and re-prepare the lab blank bag. Flag associated detections with a "B" flag.
End Check	At the end of the analytical sequence	Recoveries within 70–130% with 2 target analytes not exceeding 60–140%. The recovery for Hydrogen Sulfide, Carbonyl Sulfur and Carbon Disulfide must be 70–130%.	Re-analyze the standard to confirm loading procedure. If the 2nd analysis fails, identify and correct the problem. If possible re-analyze all or a subset samples after the last compliant QC check. If re-analysis within hold-time is not possible, flag data affected data. No flags are required if recovery is high and no associated compounds are detected.

Laboratory Duplicates – LCS/LCSD	One per analytical batch	RPD $\leq$ 25%	Verify that the sample or LCS is securely attached to the sample introduction line. If a problem is identified, document in the run log and re-analyze the duplicate pair. If no loading problem is identified, narrate exceedances. If LCSD is analyzed immediately after LCS and precision is not met, notify manager or technical support team before proceeding with sample analysis.

ANALYTICAL METHODS

Section 7.0

Method: Modified EPA Methods TO-4A/TO-10A Pesticides and PCBs

Eurofins Air Toxics SOP #26 Revision 18 Effective Date: December 27, 2013 Methods Manual Summary

Description: These methods involve drawing a measured volume of air through a filter and PUF cartridge to collect pesticides and Aroclors in the vapor and particulate phases. EPA Method TO-4A describes the use of a high-volume sampling pump which allows for up to 300 cubic meters (m^3) of air to be collected over a 24-hour period, while the TO-10A method describes a low-volume sample application suitable for indoor air. Filters are not required for TO-10A sample collection. The sample media is extracted in the laboratory using Soxhlet extraction or Pressurized Fluid Extraction (PFE). The extracts are solvent-exchanged to hexane, concentrated to a final volume, and analyzed for chlorinated pesticides and PCBs using a gas chromatograph (GC) equipped with a dual Electron Capture Detector (ECD) for detection and confirmation.

Certain compounds are not included in Eurofins Air Toxics' standard target analyte list. These compounds are communicated at the time of client proposal request. Unless otherwise directed, the laboratory reports these non-standard compounds with partial validation. Validation includes a 3-point calibration with the lowest concentration defining the reporting limit, no second source verification is analyzed, and no method detection limit study is performed unless previous arrangements have been made. For the extraction process, the non-standard compound recovery is evaluated in the extracted laboratory control spike. In addition, stability of the non-standard compound during sample storage is not validated. Full validation may be available upon request.

Eurofins Air Toxics performs modified versions of these methods. The method modifications, standard target analyte list, reporting limit (RL) Quality Control (QC) criteria, and QC summary can be found in the following tables.

Table 1. Summary of Method Modifications for TO-4A/TO-10A

Requirement	EPA Methods TO-4A/TO-10A	Eurofins Air Toxics Modifications
Extraction Solvent	10% (5% for TO-10A) Diethyl Ether in Hexane	Dichloromethane (DCM) exchanging to Hexane during the concentration step
Reagent Blank	Set up extraction system without filter/PUF; reflux with solvent.	No Reagent Blank is extracted. Reagent lots are certified as acceptable prior to use.
Media certification (TO-10A only)	< 0.01 µg for single peak analytes; < 0.1 µg for PCBs	< Reporting Limit for all analytes
Frequency of Continuing Calibration Verification (CCV)	Every 10 samples	Every 20 samples with internal standard
PCB Quantitation	Requires a minimum of 5 peaks.	Use 4 peaks for quantitation.

Field Spike	Requires one PUF cartridge from each batch of 20 to be spiked with standard and not be used during the sampling period. The spiked PUF plug is placed in a sealed container, then extracted along with samples.	A spike is prepared at the time of sample extraction only.
Sampling Efficiency Determination	Prior to implementation of method and then periodically determine sampling efficiency by spiking PUF and sampling ambient air to determine recoveries.	No sampling efficiencies have been determined by the laboratory.

Table 2. Methods TO-4A/TO-10A Reporting and QC Limits

Analyte	RL (µg)	Low Point of the Curve (µg)	QC Acceptance Criteria			
			ICAL (%RSD)	ICV (%R)	CCV (%D)	LCS (%R)
4,4'-DDD	0.10	0.10	≤ 20	± 15	± 15	65 – 125
4,4'-DDE	0.10	0.10	≤ 20	± 15	± 15	65 – 125
4,4'-DDT	0.10	0.10	≤ 20	± 15	± 15	65 – 125
4,4'-Methoxychlor	1.0	1.0	≤ 20	± 15	± 15	65 – 125
Aldrin	0.10	0.10	≤ 20	± 15	± 15	65 – 125
alpha-BHC	0.10	0.10	≤ 20	± 15	± 15	65 – 125
cis-Chlordane	0.10	0.10	≤ 20	± 15	± 15	65 – 125
Aroclor 1016/1242	1.0	1.0	≤ 20	± 15	± 15	65 – 125
Aroclor 1221[①]	1.0	NA	≤ 20	± 15	± 15	
Aroclor 1232[①]	1.0	NA	≤ 20	± 15	± 15	
Aroclor 1248[①]	1.0	NA	≤ 20	± 15	± 15	
Aroclor 1254[①]	1.0	NA	≤ 20	± 15	± 15	
Aroclor 1260	1.0	1.0	≤ 20	± 15	± 15	65 – 125
beta-BHC	0.10	0.10	≤ 20	± 15	± 15	65 – 125
delta-BHC	0.10	0.10	≤ 20	± 15	± 15	65 – 125
Dieldrin	0.10	0.10	≤ 20	± 15	± 15	65 – 125
Endosulfan I	0.10	0.10	≤ 20	± 15	± 15	65 – 125
Endosulfan II	0.10	0.10	≤ 20	± 15	± 15	65 – 125
Endosulfan Sulfate	0.10	0.10	≤ 20	± 15	± 15	65 – 125
Endrin	0.10	0.10	≤ 20	± 15	± 15	65 – 125
Endrin Aldehyde*	0.10	0.10	≤ 20	± 15	± 15	65 – 125
Endrin Ketone	0.10	0.10	≤ 20	± 15	± 15	65 – 125
gamma-BHC (Lindane)	0.10	0.10	≤ 20	± 15	± 15	65 – 125
trans-Chlordane	0.10	0.10	≤ 20	± 15	± 15	65 – 125
Heptachlor	0.10	0.10	≤ 20	± 15	± 15	65 – 125
Heptachlor Epoxide	0.10	0.10	≤ 20	± 15	± 15	65 – 125
Technical Chlordane[①④]	1.0	NA	≤ 20	± 15	± 15	
Toxaphene[①]	1.0	NA	≤ 20	± 15	± 15	

Mirex is not included in the standard pesticides list but can be performed upon request.

*Internal studies have shown poor recoveries of Endrin Aldehyde from PUF cartridge. In-house generated control limits are used to evaluate recovery of this compound.

Surrogates③

Analyte	%R
2,4,5,6-Tetrachloro-m-xylene (TCMX)	60 – 120②
Decachlorobiphenyl (DCB)	60 – 120②

① *The noted multi-component compounds use a one-point calibration.*
② *Recovery limits are derived from Compendium Method TO-10A January 1999.*
③ *Recovery limits are for extracted samples only. Non-extracted samples use limits of 85–115 %R.*
④ *Not routinely reported but available at client request.*

Table 3. Summary of Calibration and QC Procedures for Methods TO-4A/TO-10A

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
5-Point Initial Calibration Curve (ICAL)*	Prior to sample analysis	%RSD ≤ 20 for each compound or average %RSD ≤ 20.	Use linear regression per SW-846 or re-calibrate.
Independent Calibration Verification (ICV)	After each Initial Calibration	Recovery of an individual component or the average of all the target components for a list of 5 or more target components within 85–115% recovery. Not to exceed 75–125% for any individual compounds.	Investigate the source of discrepancy, including re-preparation and re-analysis of standard. Re-calibrate if needed.
Breakdown Check (Endrin and p,p'-DDT)	Daily, prior to Initial Curve; CCV for pesticide analysis only.	Degradation ≤ 15%	Perform maintenance. Repeat breakdown check.
Continuing Calibration Verification (CCV)	Daily, prior to sample analysis, every 20 samples, and at the end of the analysis sequence, at a minimum of every 24 hours.	Recovery of an individual component or the average of all the pesticide target components for a list of 5 or more target components, within 15% of the expected values. Not to exceed 75–125% for any individual compounds.	Analyze new ICAL and/or prepare fresh standards. If the standard analyzed is recovering high and associated samples are ND, "Q" flag the high recoveries. If the standard analyzed is recovering low, re-analyze all samples.
Laboratory Control Spike (LCS) for compounds noted in Table 2.	Extracted with each set of up to 20 samples	As mentioned in Table 2	Analyze another aliquot. If it still fails, "Q" flag the compounds that are outside the control limits.

Surrogates	All samples, QC, and blanks prior to extraction	As mentioned in Table 2	Analyze another aliquot. If it still fails, "Q" flag the compounds outside the control limits.
Internal Standard	With all analyses	CCV 50–200% compared to midpoint of ICAL; samples 50–200% compared to first CCV of the daily analytical batch.	Analyze another aliquot. If a CCV fails, correct problem before proceeding. If a sample fails, analyze a second time. If it still fails, dilute the sample until IS meets the criteria. Narrate the matrix interference.
Laboratory Blanks	With each set of up to 20 samples extracted	Results less than the Laboratory reporting limit.	Analyze another aliquot. If it still fails, "B" flag the compounds that do not meet the acceptance criteria.
Laboratory Duplicates Laboratory Control Spike Duplicate	One per analytical batch	RPD ≤ 25%	Narrate exceedances. Investigate the cause and perform maintenance as required and re-calibrate as needed.
Second-Column Confirmation	100% for all positive results, for both pesticide and PCB analyses	Same as for initial or primary column analysis	Same as for initial or primary column analysis

* A single-point calibration is performed for Technical Chlordane, Toxaphene, and certain Aroclors.

ANALYTICAL METHODS

Section 8.0

Method: EPA Method TO-12 (Non-methane Organic Compounds)

Eurofins Air Toxics SOP #36 Revision 16 Effective Date: April 03, 2013 Methods Manual Summary

Description: This method involves gas chromatograph analysis of whole air samples collected in Summa™ canisters or Tedlar bags. Samples are analyzed for Non-Methane Organic Compounds (NMOC) using EPA Method TO-12 protocols. After concentration on a sorbent bed, samples are analyzed using a Flame Ionization Detector (FID). This method is used when speciation is not required.

NMOC concentrations are quantified using the response factor of heptane. As required by the project, NMOC results referenced to heptane can be converted to units of ppmC (parts per million of Carbon). Additionally, hydrocarbon ranges can be provided based on the elution time of the normal alkanes on the GC column.

Eurofins Air Toxics performs a modified version for each of these methods. The method modifications, standard target analyte list, RL, QC criteria, and QC summary can be found in the following tables.

Table 1. Summary of Method Modifications for TO-12

Requirement	EPA Method TO-12	Eurofins Air Toxics Modifications
Reporting Limit	0.02 ppmC	0.010 ppmv
Initial Calibration	Five levels: Each level three runs with %RSD < 3%; linearity criterion not specified	Minimum of three single levels; %RSD ≤ 30%.
Sample Analysis Frequency	Duplicate analysis with RPD<5%; report average results of two analyses.	Single analysis. Duplicate 10% of samples with RPD ≤ 25% for detections > 5X the RL.
Column*	GC column not used.	GC column used for analysis.
Sample concentration	Cyrogenic concentration	Multibed sorbent concentration

* The column modification implemented for sample analysis allows for additional characterization based on carbon ranges.

Table 2. Method Compound List and QC Limits

Analyte	RL (ppmv)	Acceptance Criteria		
		ICAL (%RSD)	LCS/CCV (%R)	Precision (%RPD)
Total NMOC ref. to Heptane	0.010	≤ 30	75-125%	≤ 25

Table 3. Summary of Calibration and QC Procedures for TO-12 (NMOC)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Initial Calibration Curve (ICAL)	Prior to sample analysis and/or annually	% RSD ≤ 30	Repeat the calibration.
Laboratory Control Sample (LCS)	With each initial calibration and analytical batch	75–125% of the expected value	Check the system and re-analyze the standard. Re-calibrate the instrument if the criteria cannot be met.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis and after every 20 samples or at the end of the analytical sequence	% Difference ± 25 of expected value	Check the system and re-analyze the standard. Re-calibrate the instrument if the criteria cannot be met. Re-analyze all samples since the last acceptable CCV.
Laboratory Blank	In between analysis of standards and project samples	Results less than laboratory reporting limit	Repeat the Laboratory Blank. If the re-analysis of the Lab Blank contains above but at less than 5X the reporting limit, sample analysis may proceed and the associated sample results will be reported with a B flag.
Laboratory Duplicates/ Laboratory Control Spike Duplicate (LCSD)	One per analytical batch	RPD ≤ 25%	Narrate exceedances. Investigate the cause and perform maintenance as required and re-calibrate as needed.

ANALYTICAL METHODS

Section 9.0

Method: EPA Method TO-14A/TO-15 Volatile Organic Compounds by SIM

Eurofins Air Toxics SOP #38 Revision 17 Effective Date: December 27, 2013 Methods Manual Summary

Description: This method involves Selective Ion Monitoring (SIM) gas chromatograph/mass spectrometer (GC/MS) analysis of whole air samples collected in evacuated stainless steel canisters. Samples are analyzed for volatile organic compounds (VOCs) using EPA Method TO-14A/TO-15 protocols. An aliquot of the sample is withdrawn from the canister through a mass flow controller and concentrated onto a hydrophobic drying system that removes water from the sample stream. The sample is then focused onto a cryogenic-cooled column prior to analysis by GC/MS in the SIM mode.

Mass spectrometer detectors can be set to acquire both SIM and full scan data simultaneously. This generates two separate data files in the analytical software. One file contains full scan data and the other contains SIM data for selected compounds. The results for each sample in a report will be from two separate data files originating from the same analytical run. The two data files have the same base file name and are differentiated with a "sim" extension on the SIM data file.

Eurofins Air Toxics maintains a suite of TO-14A/TO-15 methods, each optimized to efficiently meet the data objectives for a wide range of targeted concentration ranges. The methods, their reporting limits, and typical applications are summarized in the table below. This method summary describes TO-14A/TO-15 SIM.

Eurofins Air Toxics Method	Base Reporting Limits	Typical Application
TO-14A/TO-15 (5&20)	5 – 20 ppbv	Soil gas and ppmv range vapor matrices
TO-14A/TO-15 (Standard or Quad)	0.5 – 5.0 ppbv	Ambient air, soil gas, and ppbv level vapor matrices
TO-14A/TO-15 (Low-level)	0.1 – 0.5 ppbv	Indoor and outdoor air
TO-14A/TO-15 SIM	0.003 – 0.5 ppbv	Indoor and outdoor air

Certain compounds are not included in Eurofins Air Toxics' standard target analyte list. These compounds are communicated at the time of client proposal request. If full validation of the required compound(s) is not available, the laboratory will present Quality Control (QC) options to the client based on the project objectives.

Please note that Methods TO-14A and TO-15 were validated for specially treated canisters. As such, the use of Tedlar bags for sample collection is outside the scope of the method and not recommended for ambient or indoor air samples. It is the responsibility of the data user to determine the usability of TO-14A and TO-15 results generated from Tedlar bags.

All samples submitted for TO-15 SIM are screened prior to analysis. If samples contain high concentrations of target and/or non-target VOCs, samples may be analyzed by an alternative TO-15 method (i.e. Standard or 5&20) with a higher dynamic calibration range.

Eurofins Air Toxics performs a modified version of TO-15 SIM as detailed in Table 1. Additionally, since Eurofins Air Toxics applies TO-15 methodology to all Summa™ canisters regardless of whether TO-14A or TO-15 is specified by the project, Eurofins Air Toxics performs a modified version of method TO-14A as described in Table 2. The default SIM target list, reporting limits (RL), QC criteria and QC summary may be found in tables 3 and 4.

Table 1. Summary of TO-15 SIM Method Modifications

Requirement	TO-15	Eurofins Air Toxics Modifications
Blank and standards	Zero Air	Nitrogen

Table 2. Summary of TO-14A SIM Method Modifications

Requirement	TO-14A	Eurofins Air Toxics Modifications
Sample Drying System	Nafion Dryer	Multibed hydrophobic sorbent
ICAL %RSD acceptance criteria	≤ 30% RSD for listed 39 VOCs	Follow TO-15 requirements of ≤ 30%RSD with 2 of standard compound list allowed out to ≤ 40%RSD
Blank and standards	Zero air	Nitrogen
BFB ion abundance criteria	Ion abundance criteria listed in Table 4 of TO-14A	Follow abundance criteria listed in TO-15.
BFB absolute abundance criteria	Within 10% when comparing to the previous daily BFB	CCV internal standard area counts are compared to ICAL; corrective action when recovery is less than 60%

Table 3. Method TO-14A/TO-15 Standard Analyte List (SIM) and QC Limits

Analyte	RL/LOQ (ppbv)	QC Acceptance Criteria			
		ICAL (%RSD)	CCV (%R)	ICV/LCS (%R)	Precision Limits (Max. RPD)
Dichlorodifluoromethane (Fr12)	0.020	≤ 30%	70 – 130	70 – 130	± 25
Freon 114	0.020	≤ 30%	70 – 130	70 – 130	± 25
Chloromethane	0.050	≤ 30%	70 – 130	70 – 130	± 25
Vinyl Chloride	0.010	≤ 30%	70 – 130	70 – 130	± 25
Chloroethane	0.050	≤ 30%	70 – 130	70 – 130	± 25
1,1-Dichloroethene	0.010	≤ 30%	70 – 130	70 – 130	± 25
Trans-1,2-Dichloroethene	0.100	≤ 30%	70 – 130	70 – 130	± 25
Methyl tert-Butyl Ether	0.100	≤ 30%	70 – 130	70 – 130	± 25
1,1-Dichloroethane	0.020	≤ 30%	70 – 130	70 – 130	± 25
cis-1,2-Dichloroethene	0.020	≤ 30%	70 – 130	70 – 130	± 25
Chloroform	0.020	≤ 30%	70 – 130	70 – 130	± 25
1,1,1-Trichloroethane	0.020	≤ 30%	70 – 130	70 – 130	± 25
Carbon Tetrachloride	0.020	≤ 40%	60 - 140	60 - 140	± 25
Benzene	0.050	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dichloroethane	0.020	≤ 30%	70 – 130	70 – 130	± 25
Trichloroethene	0.020	≤ 30%	70 – 130	70 – 130	± 25
Toluene	0.020	≤ 30%	70 – 130	70 – 130	± 25
1,1,2-Trichloroethane	0.020	≤ 30%	70 – 130	70 – 130	± 25
Tetrachloroethene	0.020	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dibromoethane	0.020	≤ 30%	70 – 130	70 – 130	± 25
Ethyl Benzene	0.020	≤ 30%	70 – 130	70 – 130	± 25
m,p-Xylene	0.040	≤ 30%	70 – 130	70 – 130	± 25
o-Xylene	0.020	≤ 30%	70 – 130	70 – 130	± 25
1,1,2,2-Tetrachloroethane	0.020	≤ 30%	70 – 130	70 – 130	± 25
1,4-Dichlorobenzene	0.020	≤ 30%	70 – 130	70 – 130	± 25
Naphthalene	0.050	≤ 40%	60 – 140	60 – 140	± 25

Table 3 is the list of Standard compounds, reporting limits and QC acceptance criteria. Each project may be customized as needed. Additional compounds and different reporting limits may be obtainable and/or achieved upon request.

Table 4. Summary of Calibration and QC Procedures for Methods TO-14A/TO-15 by SIM

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Every 24 hours	TO-15 Ion Abundance criteria	Correct problem then repeat tune.
Multi-point Calibration (Minimum of 5 points)	Prior to sample analysis	≤ 30% for standard compounds with 2 compounds allowed out to ≤ 40% RSD	Correct problem then repeat Initial Calibration Curve.
Initial Calibration Verification and Laboratory Control Spike (ICV and LCS)	After each initial calibration curve, and daily prior to sample analysis	Recoveries for 85% of standard compounds must be 70–130% (≤ 40% for Methyl tert-Butyl Ether and trans-1,2-Dichloroethene). No recovery may be ≤ 50%. If specified by the client, in-house generated control limits may be used.	Check the system and re-analyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.
Initial Calibration Verification and Laboratory Control Spike (ICV and LCS) for Non-Standard Compounds	Per client request or specific project requirements only	Recoveries of compounds must be 60–140%. No recovery may be ≤ 50%.	Check the system and re-analyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.
Continuing Calibration Verification (CCV)	At the start of each day after the BFB tune check	70–130%	Compounds exceeding this criterion and associated data will be flagged and narrated with the exception of high bias associated with non-detects. If more than two compounds from the standard list recover outside of 70–130%, corrective action will be taken. If any compound exceeds 60–140%, samples are not analyzed unless data meets project needs. Check the system and re-analyze the standard. Re-prepare the standard if necessary. Re-calibrate the instrument if the criteria cannot be met.
Continuing Calibration Verification (CCV) for Non-Standard Compounds	Per client request or specific project requirements only	Recoveries of compounds must be 60–140%. No recovery may be ≤ 50%.	Check the system and re-analyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.

Laboratory Blank	After analysis of standards and prior to sample analysis, or when contamination is present.	Results less than the laboratory reporting limit (Table 4) or project required reporting limit.	Inspect the system and re-analyze the blank. "B" flag data for common contaminants.
Internal Standard (IS)	As each standard, blank, and sample is being loaded	Retention time (RT) for blanks and samples must be within ±0.33 min of the RT in the CCV and within ±40% of the area counts of the daily CCV internal standards.	**For blanks:** Inspect the system and re-analyze the blank. **For samples:** Re-analyze the sample. If the ISs are within limits in the re-analysis, report the second analysis. If ISs are out-of-limits a second time, dilute the sample until ISs are within acceptance limits and narrate.
Surrogates	As each standard, blank, and sample is being loaded	70–130% If specified by the client, in-house generated control limits may be used.	**For blanks:** Inspect the system and re-analyze the blank. **For samples:** Re-analyze the sample unless obvious matrix interference is documented. If the %Rs are within limits in the re-analysis, report the second analysis. If %Rs are out-of-limits a second time, report data from first analysis and narrate.
Laboratory Duplicates - Laboratory Control Spike Duplicate (LCSD)	One per analytical batch	RPD ≤ 25%	Narrate exceedances. If more than 5% of compound list outside criteria or if compound is > 40%RPD, investigate the cause and perform maintenance as required. If instrument maintenance is required, calibrate as needed.

ANALYTICAL METHODS

Section 10.0

Method: EPA Methods TO-3 and TO-14A (BTEX/TPH)

Eurofins Air Toxics SOP #43 Revision 20 Effective Date: April 02, 2013 Methods Manual Summary

Description: This method involves GC analysis of whole air samples collected in Summa canisters or Tedlar bags. Samples are analyzed for Benzene, Toluene, Ethylbenzene, Xylenes, (BTEX) and Total Petroleum Hydrocarbons (TPH). Either modified EPA Method TO-3 or Method TO-14A or can be used to reference laboratory protocols. BTEX is measured using a Photo Ionization Detector (PID), and TPH is measured using a Flame Ionization Detector (FID). Depending on the client's request, TPH is analyzed and referenced to either gasoline or jet fuel.

Certain compounds are not included in Eurofins Air Toxics' standard target analyte list. These compounds are communicated at the time of client proposal request. Unless otherwise directed, the laboratory reports these non-standard compounds with partial validation. Validation includes a 3-point calibration with the lowest concentration defining the reporting limit, no second source verification is analyzed, and no method detection limit study is performed unless previous arrangements have been made. In addition, stability of the non-standard compound during sample storage is not validated. Full validation may be available upon request.

Eurofins Air Toxics performs a modified version for these methods. The method modifications, standard target analyte list, reporting limit (RL), QC criteria, and QC summary can be found in the following tables.

Table 1. Summary of Method Modifications for TO-14A

Requirement	EPA Method TO-14A	Eurofins Air Toxics Modifications
Sample Drying System*	Nafion Dryer	Multi-bed sorbent
Sample collection containers	Specially treated stainless steel canisters	Method TO-14A is validated for samples collected in specially treated canisters. As such, the use of Tedlar bags for sample collection is outside the scope of the method and not recommended for ambient or indoor air samples. Associated results are considered qualified.

* The pre-concentrator modification implemented for sample analysis allows for superior performance over the water management and concentration procedures outlined in Method TO-14A. This multi-bed sorbent approach used in EPA Method TO-15 allows for the inclusion of polar compounds such as MTBE, and demonstrates superior performance by minimizing carryover issues that can be problematic using the Nafion dryer scenario described in Method TO-14A.

Table 2. Summary of Method Modifications for TO-3

Requirement	EPA Method TO-3	Eurofins Air Toxics Modifications
Sample Collection	In-line field method	Collection of sample in specially treated canisters or alternative containers for transport to and analysis by an off-site laboratory.
Preparation of Standards	Levels achieved through dilution of gas mixture	Levels achieved through loading various volumes of the gas mixture.
Initial Calibration Calculation	4-point calibration using a linear regression model	5-point calibration using average Response Factor
Initial Calibration Frequency	Weekly	When daily calibration standard recovery is outside 75–125%, or upon significant changes to the procedure or instrumentation.
Daily Calibration Standard Frequency	Prior to sample analysis and every 4-6 hrs	Prior to sample analysis
Minimum Detection Limit (MDL)	Calculated using the equation DL = A+3.3S, where A is intercept of calibration line and S is the standard deviation of at least 3 reps of low level standard.	40 CFR Part 136, App. B
Sample pre-concentration and moisture management	Cyrogenic pre-concentrator with a Nafion dryer	Multi-bed sorbent system

Table 3. Method Compound List and QC Limits

Analyte	RL (ppmv)	Acceptance Criteria		
		ICAL (%RSD)	LCS/CCV (%R)	Precision (%RPD)
Benzene	0.001	≤ 30	± 25	≤ 25
Toluene	0.001	≤ 30	± 25	≤ 25
Ethyl Benzene	0.001	≤ 30	± 25	≤ 25
m,p-Xylenes	0.001	≤ 30	± 25	≤ 25
o-Xylene	0.001	≤ 30	± 25	≤ 25
MTBE	0.001	≤ 30	± 25	≤ 25
TPH (Gasoline Range) MW = 100	0.025	≤ 30	± 25	≤ 25
TPH (JP-4 Range) MW = 156	0.025	≤ 30	± 25	≤ 25

Table 4. Surrogate QC Limits

Surrogate	PID Accuracy (%R)	FID Accuracy (%R)
Fluorobenzene	75–125%	75–150%

Table 5. Summary of Calibration and QC Procedures for TO-3/TO-14A (BTEX & TPH)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
5-Point Initial Calibration (ICAL)	Prior to sample analysis and annually	%RSD ≤ 30	Correct problem, then repeat the calibration.
Initial Calibration Verification and Laboratory Control Sample (ICV/LCS)	With each initial calibration, and with each analytical batch.	±25% of the expected value	Check the system and re-analyze the standard. Re-prepare the standard or re-calibrate the instrument if the criteria cannot be met.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis and can be used as an End Check	±25% of the expected value	**For initial CCV:** Check the system and re-analyze the standard. Re-calibrate the instrument if the criteria cannot be met. **For Mid- and End Checks:** Check system and re-analyze the standard. If the second analysis fails, identify and correct the problem, then re-analyze all samples since the last acceptable CCV.
Laboratory Blank	In between analysis of standards and project samples	Results less than the laboratory Reporting Limit	Inspect the system and re-analyze the Laboratory Blank.
Surrogate	As each standard, blank, and sample is being loaded	75–125% recovery on the PID; 75–150% on the FID	Low surrogate recovery results in re-analysis (at a higher dilution if high levels of moisture are present). If recovery is out and still low, report the analysis with the better recovery and flag. Because of TPH interference, high surrogate recoveries do not result in re-analysis. Data is flagged to note high recovery.
Laboratory Duplicate - Laboratory Control Spike Duplicate (LCSD)	One per analytical batch	RPD ≤ 25%	Narrate exceedances. Investigate the cause, perform maintenance as required, and re-calibrate as needed.

ANALYTICAL METHODS

Section 11.0

Method: ASTM D1945 – Fixed Gases & C1-C6

Eurofins Air Toxics SOP #54 Revision 18 Effective Date: December 27, 2013 Methods Manual Summary

Description: This method involves gas chromatograph (GC) analysis of soil gas, landfill gas, ambient air, or stack gas collected in Summa™ canisters, Tedlar bags, or any vessel that has been demonstrated to be clean and leak free. Samples are analyzed for Methane and fixed gases and can be used to speciate individual light hydrocarbons up to C6. This method is also used to provide an estimation of the heating value of the gas by method ASTM D3588. Because the sample is withdrawn from the vessel by positive pressure, rigid containers are first filled to positive pressure using UHP Helium or Nitrogen. Samples are then analyzed using a GC equipped with a Flame Ionization Detector (FID) and a Thermal Conductivity Detector (TCD).

Certain compounds are not included in Eurofins Air Toxics' standard target analyte list. These compounds are communicated at the time of client proposal request. Unless otherwise directed, the laboratory reports these non-standard compounds with partial validation. Validation includes a 3-point calibration with the lowest concentration defining the reporting limit (RL), no second source verification is analyzed, and no method detection limit study is performed unless previous arrangements have been made. In addition, stability of the non-standard compounds during sample storage is not validated. Full validation may be available upon request.

Since the protocols in the ASTM D1945 standard were designed for the analysis of natural gas, the laboratory has made modifications in order to apply the method to environmental samples covering a wide concentration range and to implement standard NELAP and EPA calibration criteria. The method modifications, standard target analyte list, RL, Quality Control (QC) criteria, and QC summary can be found in the following tables.

Table 1. Summary of Method Modifications for ASTM D1945

Requirement	ASTM D1945	Eurofins Air Toxics Modifications
Sample Injection Volume	0.50 mL to achieve Methane linearity.	1.0 mL
Reference Standard	Concentration should not be < half of nor differ by more than 2X the concentration of the sample. Run 2 consecutive checks; must agree within 1%.	A minimum 3-point linear calibration. The acceptance criterion is RSD ≤ 15%. All target analytes must be within the linear range of calibration (with the exception of O_2, N_2, and C6+ hydrocarbons).
Sample Analysis	Equilibrate samples to 20-50° F above source temperature at field sampling.	No heating of samples is performed.
Sample Calculation	Response factor is calculated using peak height for C5 and lighter compounds.	Peak areas are used for all target analytes to quantitate concentrations.

Normalization	Sum of original values should not differ from 100.0% by more than 1.0%.	Sum of original values may range between 85–115%; normalization of data not performed unless client requested.

Table 2. ASTM Method D1945 Compound List and QC Limits

Analyte	Reporting Limit (%)	QC Acceptance Criteria		
		ICAL (%RSD)	CCV/LCS/ICV (%R)	Precision* (%RPD)
Carbon Dioxide	0.01	≤ 15%	± 15%	≤ 25%
Carbon Monoxide	0.01	≤ 15%	± 15%	≤ 25%
Ethene	0.001	≤ 15%	± 15%	≤ 25%
Ethane	0.001	≤ 15%	± 15%	≤ 25%
Acetylene	0.001	≤ 15%	± 15%	≤ 25%
Isobutane	0.001	≤ 15%	± 15%	≤ 25%
Isopentane	0.001	≤ 15%	± 15%	≤ 25%
Methane	0.0001	≤ 15%	± 15%	≤ 25%
n-Butane	0.001	≤ 15%	± 15%	≤ 25%
Neopentane	0.001	≤ 15%	± 15%	≤ 25%
n-Pentane	0.001	≤ 15%	± 15%	≤ 25%
Nitrogen**	0.10	≤ 15%	± 15%	≤ 25%
NMOC (C6+)	0.01	≤ 15%	± 15%	≤ 25%
Oxygen	0.10	≤ 15%	± 15%	≤ 25%
Propane	0.001	≤ 15%	± 15%	≤ 25%
Hydrogen***	0.01	≤ 15%	± 15%	≤ 25%
Helium****	0.05	≤ 15%	± 15%	≤ 25%

* For detections at > 5X the Reporting Limit.
**For canisters that have been pressurized with Nitrogen, the amount of Nitrogen in the sample is determined by subtraction.
***For canisters that have been pressurized with Helium, the Reporting Limit is 1.0%.
****Included by special request only.

Note: Results are reported in units of mol %. If required to report volume % or ppmV, a compressibility factor of 1 for all gases will be assumed. As a result, mol % is assumed to be equivalent to volume %. This assumption may result in a bias for highly compressible gases at high concentrations and pressures.

Table 3. Summary of Calibration and QC Procedures for Mod. ASTM Method D1945

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Initial Calibration (ICAL)	Prior to sample analysis and annually	≤ 15% RSD	Correct problem, then repeat Initial Calibration.
Initial Calibration Verification and Laboratory Control Spike (ICV and LCS)	After each Initial Calibration and once per analytical batch.	85–115% Recovery If specified by the client, in-house generated control limits may be used.	Check the system and re-analyze the standard. Re-prepare the standard if necessary. If the primary standard is found to be in error, re-prepare the primary and calibrate the instrument.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis, and can be used as an End Check.	± 15% Difference	Check the system and re-analyze the standard. Re-prepare the standard if necessary. Re-calibrate the instrument if the criteria cannot be met. If the closing CCV fails, the system is checked and the standard is re-analyzed. Re-prepare the standard if necessary. If the second analysis fails, identify and correct the problem, then re-analyze all samples since the last acceptable CCV.
Laboratory Blank	After analysis of standards and prior to sample analysis, or when contamination is present.	Results less than the laboratory Reporting Limit	Inspect the system and re-analyze the Laboratory Blank.
Laboratory Duplicates-Laboratory Control Spike Duplicate (LCSD)	One per analytical batch	RPD ≤ 25%	Narrate exceedances. Investigate the cause and perform maintenance as required and re-calibrate as needed.

ANALYTICAL METHODS

Section 12.0

Method: PM10/TSP – Particulate Matter

Eurofins Air Toxics SOP #66 Revision 13 Effective Date: December 30, 2013 Methods Manual Summary

Description: This method involves equilibrating quartz filters in a conditioning environment of a specified temperature and humidity range and weighing the filters before and after field sampling. Samples are analyzed for method PM_{10} using 40 CFR Part 50 Appendix J or for Total Suspended Particulate (TSP) using 40 CFR Part 50 Appendix B. An analytical balance with 0.1 mg resolution is used to measure the filter weights. The corresponding change in mass represents the TSP or PM_{10} result, expressed in µg or µg/m^3. The reporting limit is typically 1000 µg. Sampling volumes are required to calculate results in units of µg/m^3.

Table 1. Conditioning Environment Criteria for Methods PM10 and TSP

Method	Conditioning Environment Temperature (˚F)	Conditioning Environment Relative Humidity (%)
PM10	59°F – 86°F ± 5°F	20% – 45% ± 5%
TSP	59°F – 86°F ± 5°F	≤ 50% ± 5%

Table 2. Summary of Calibration and QC Procedures for Methods PM10 and TSP

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Calibration	Calibration checks of 3.00 grams (g) and 5.00 g are weighed to bracket the expected filter weight of ~4.5 g prior to sample analysis and at the end of the analytical batch.	Accuracy limits of 3.00 g weight: 2.997 g – 3.003 g Accuracy limits of 5.00 g weight: 4.995 g - 5.005 g	Correct problem then repeat calibration.
Laboratory Duplicates	Unexposed filters: One per analytical batch Exposed filters: One duplicate per work order	Unexposed filters: Weights of the clean filters should be within ±0.0028 g of the original value. Exposed filters: ≤ 25% RPD and weights must be within ±0.005 g	Re-condition the filter and re-weigh.
Laboratory Blanks	Immediately after the calibration checks	Post-weight of Lab Blank is less than pre-weight and the difference is < 0.0028 g.	Confirm the weight difference and narrate.

ANALYTICAL METHODS

Section 13.0

Method: EPA Method TO-14A/TO-15 Volatile Organic Compounds (Low-Level)

Eurofins Air Toxics SOP #83 Revision 12 Effective Date: February 13, 2014 Methods Manual Summary

Description: This method involves full scan gas chromatograph/mass spectrometer (GC/MS) analysis of whole air samples collected in evacuated stainless steel canisters. Samples are analyzed for volatile organic compounds (VOCs) using EPA Method TO-14A/TO-15 protocols. An aliquot of up to 250 mL of air is withdrawn from the canister utilizing a volumetric syringe, volumetric loop, or mass flow controller. This volume is loaded onto a hydrophobic multibed sorbent trap to remove water and carbon dioxide and to concentrate the vapor sample. The focused sample is then flash-heated to sweep adsorbed VOCs onto a GC/MS for separation and detection. Compounds are detected using a MS operating in full scan mode.

Eurofins Air Toxics maintains a suite of TO-14A/TO-15 methods, each optimized to efficiently meet the data objectives for a wide range of targeted concentration ranges. The methods, their reporting limits, and typical applications are summarized in the table below. This method summary describes TO-14A/TO-15 (Low-Level).

Eurofins Air Toxics Method	Base Reporting Limits	Typical Application
TO-14A/TO-15 (5&20)	5 – 20 ppbv	Soil gas and ppmv range vapor matrices
TO-14A/TO-15 (Standard or Quad)	0.5 – 5.0 ppbv	Ambient air, soil gas, and ppbv level vapor matrices
TO-14A/TO-15 (Low-Level)	0.1 – 0.5 ppbv	Indoor and outdoor air
TO-14A/TO-15 SIM	0.003 – 0.5 ppbv	Indoor and outdoor air

Certain compounds are not included in Eurofins Air Toxics' standard target analyte list. These compounds are communicated at the time of client proposal request. Unless otherwise directed, Eurofins Air Toxics reports these non-routine compounds with partial validation. Validation may include a 3-point calibration with the lowest concentration defining the reporting limit, no second source verification analyzed, and no method detection limit study performed unless previous arrangements have been made. In addition, stability of the non-standard compound during sample storage is not validated. Full validation may be available upon request.

Since Eurofins Air Toxics applies TO-15 methodology to all Summa™ canisters regardless of whether TO-14A or TO-15 is specified by the project, Eurofins Air Toxics performs a modified version of method TO-14A as detailed in Table 1. Please note that Methods TO-14A and TO-15 were validated for specially treated canisters. As such, the use of Tedlar bags for sample collection is outside the scope of the method and is not recommended for ambient or indoor air samples. It is the responsibility of the data user to determine the usability of TO-14A and TO-15 results generated from Tedlar bags.

All samples submitted for TO-15 Low-Level are screened prior to analysis. If samples contain high concentrations of target and/or non-target VOCs, samples may be analyzed by an alternative TO-15 method (i.e., Standard or 5&20) with a higher dynamic calibration range.

Table 1. Summary of TO-14A Method Modifications

Requirement	TO-14A	Eurofins Air Toxics Modifications
Sample Drying System	Nafion Dryer	Multibed hydrophobic sorbent
Blank acceptance criteria	< 0.2 ppbv	< RL
BFB ion abundance criteria	Ion abundance criteria listed in Table 4 of TO-14A	Follow abundance criteria listed in TO-15.
BFB absolute abundance criteria	Within 10% when comparing to the previous daily BFB	CCV internal standard area counts are compared to ICAL; corrective action taken when recovery is less than 60%.
Blanks and standards	Zero Air	UHP Nitrogen provides a higher purity gas matrix than zero air.
Initial Calibration	≤ 30% RSD for listed 39 VOCs	≤ 30% RSD with 4 compounds allowed out to ≤ 40%

Table 2. Summary of Method TO-15 Modifications

Requirement	TO-15	Eurofins Air Toxics Modifications
Initial Calibration	≤ 30% RSD with 2 compounds allowed out to < 40% RSD	≤ 30% RSD with 4 compounds allowed out to ≤ 40%
Blanks and standards	Zero Air	UHP Nitrogen provides a higher purity gas matrix than zero air.

The standard target analyte list, reporting limits (RL), also referred to as Limit of Quantitation (LOQ), Quality Control (QC) criteria, and QC summary can be found in tables 3 through 6.

Table 3. Method TO-14A/TO-15 Analyte List (Low-Level) and QC Limits

Analyte	RL/LOQ (ppbv)	QC Acceptance Criteria			
		ICAL (%RSD)	CCV (%R)	ICV/LCS* (%R)	Precision Limits (Max. RPD)
1,1,2,2-Tetrachloroethane	0.1	≤ 30%	70 – 130	70 – 130	± 25
1,1,2-Trichloroethane	0.1	≤ 30%	70 – 130	70 – 130	± 25
1,1-Dichloroethane	0.1	≤ 30%	70 – 130	70 – 130	± 25
1,1-Dichloroethene	0.1	≤ 30%	70 – 130	70 – 130	± 25
1,2,4-Trichlorobenzene	0.5	≤ 30%	70 – 130	70 – 130	± 25
1,2,4-Trimethylbenzene	0.1	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dibromoethane (EDB)	0.1	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dichlorobenzene	0.1	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dichloroethane	0.1	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dichloropropane	0.1	≤ 30%	70 – 130	70 – 130	± 25
1,3,5-Trimethylbenzene	0.1	≤ 30%	70 – 130	70 – 130	± 25
1,3-Dichlorobenzene	0.1	≤ 30%	70 – 130	70 – 130	± 25
1,4-Dichlorobenzene	0.1	≤ 30%	70 – 130	70 – 130	± 25
Benzene	0.1	≤ 30%	70 – 130	70 – 130	± 25
Bromomethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Carbon Tetrachloride	0.1	≤ 30%	70 – 130	70 – 130	± 25
Chlorobenzene	0.1	≤ 30%	70 – 130	70 – 130	± 25
Chloroethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Chloroform	0.1	≤ 30%	70 – 130	70 – 130	± 25
Chloromethane	0.5	≤ 30%	70 – 130	70 – 130	± 25
Chlorotoluene (Benzyl Chloride)	0.1	≤ 30%	70 – 130	70 – 130	± 25
cis-1,2-Dichloroethene	0.1	≤ 30%	70 – 130	70 – 130	± 25
cis-1,3-Dichloropropene	0.1	≤ 30%	70 – 130	70 – 130	± 25
Dichloromethane (Methylene Chloride)	0.2	≤ 30%	70 – 130	70 – 130	± 25
Ethylbenzene	0.1	≤ 30%	70 – 130	70 – 130	± 25
Freon 11 (Trichlorofluoromethane)	0.1	≤ 30%	70 – 130	70 – 130	± 25
Freon 113 (Trichlorotrifluoroethane)	0.1	≤ 30%	70 – 130	70 – 130	± 25
Freon 114	0.1	≤ 30%	70 – 130	70 – 130	± 25
Freon 12 (Dichlorodifluoromethane)	0.1	≤ 30%	70 – 130	70 – 130	± 25
Hexachlorobutadiene	0.5	≤ 30%	70 – 130	70 – 130	± 25
m,p-Xylene	0.1	≤ 30%	70 – 130	70 – 130	± 25

Methyl Chloroform (1,1,1-Trichloroethane)	0.1	≤ 30%	70 – 130	70 – 130	± 25
o-Xylene	0.1	≤ 30%	70 – 130	70 – 130	± 25
Styrene	0.1	≤ 30%	70 – 130	70 – 130	± 25
Tetrachloroethene	0.1	≤ 30%	70 – 130	70 – 130	± 25
Toluene	0.1	< 30%	70 – 130	70 – 130	± 25
trans-1,3-Dichloropropene	0.1	≤ 30%	70 – 130	70 – 130	± 25
Trichloroethene	0.1	≤ 30%	70 – 130	70 – 130	± 25
Vinyl Chloride	0.1	≤ 30%	70 – 130	70 – 130	± 25
1,3-Butadiene	0.1	≤ 30%	70 – 130	70 – 130	± 25
1,4-Dioxane	0.1	≤ 30%	70 – 130	70 – 130	± 25
2-Butanone (Methyl Ethyl Ketone)	0.5	≤ 30%	70 – 130	70 – 130	± 25
2-Hexanone	0.5	≤ 30%	70 – 130	70 – 130	± 25
4-Ethyltoluene	0.1	≤ 30%	70 – 130	70 – 130	± 25
4-Methyl-2-Pentanone (MIBK)	0.1	≤ 30%	70 – 130	70 – 130	± 25
Acetone	0.5	≤ 30%	70 – 130	70 – 130	± 25
Bromodichloromethane	0.1	≤ 30%	70 – 130	70 – 130	± 25
Bromoform	0.1	≤ 30%	70 – 130	70 – 130	± 25
Carbon Disulfide	0.5	≤ 30%	70 – 130	70 – 130	± 25
Cumene	0.1	≤ 30%	70 – 130	70 – 130	± 25
Cyclohexane	0.1	≤ 30%	70 – 130	70 – 130	± 25
Dibromochloromethane	0.1	≤ 30%	70 – 130	70 – 130	± 25
Ethanol	0.5	≤ 30%	70 – 130	70 – 130	± 25
Heptane	0.1	≤ 30%	70 – 130	70 – 130	± 25
Hexane	0.1	≤ 30%	70 – 130	70 – 130	± 25
Isopropanol	0.5	≤ 30%	70 – 130	70 – 130	± 25
Methyl tert-Butyl Ether (MTBE)	0.1	≤ 30%	70 – 130	70 – 130	± 25
Propylbenzene	0.1	≤ 30%	70 – 130	70 – 130	± 25
Tetrahydrofuran	0.5	≤ 30%	70 – 130	70 – 130	± 25
trans-1,2-Dichloroethene	0.1	≤ 30%	70 – 130	70 – 130	± 25
2,2,4-Trimethylpentane	0.5	≤ 30%	70 – 130	70 – 130	± 25
3-Chloroprene	0.5	≤ 30%	70 – 130	70 – 130	± 25

Non-Standard Compounds

Analyte	RL/LOQ (ppbv)	QC Acceptance Criteria			
		ICAL (%RSD)	CCV (%R)	ICV/LCS (%R)	Precision Limits (Max. RPD)
Acrolein	0.5	≤ 40%	60 – 140	60 – 140	± 25
Butane	0.5	≤ 40%	60 – 140	60 – 140	± 25
Ethyl tert-Butyl Ether	0.5	≤ 40%	60 – 140	60 – 140	± 25
Isopentane	0.5	≤ 40%	60 – 140	60 – 140	± 25
Isopropyl Ether	0.5	≤ 40%	60 – 140	60 – 140	± 25
Methylcyclohexane	0.5	≤ 40%	60 – 140	60 – 140	± 25
Naphthalene**	0.5	≤ 40%	60 – 140	60 – 140	± 25
Propylene	0.5	≤ 40%	60 – 140	60 – 140	± 25
tert-Amyl Methyl Ether	0.5	≤ 40%	60 – 140	60 – 140	± 25
Vinyl Acetate	0.5	≤ 40%	60 – 140	60 – 140	± 25
tert-Butyl Alcohol	0.5	≤ 40%	60 – 140	60 – 140	± 25
TPH (Gasoline)***	10	1- Point Calibration	N/A	ICV only: 60 – 140	± 25
NMOC (Hexane/Heptane)***	2.0	1- Point Calibration	N/A	N/A	± 25

*See Table 6.

**Due to its low vapor pressure, Naphthalene does not meet TO-15 performance requirements. The wider QC limits reflect typical performance. Although Naphthalene is not on Eurofins Air Toxics "standard" TO-15 list, it is commonly requested and therefore included in Table 3.

***TPH and NMOC are not on Eurofins Air Toxics' standard TO-15 list, but are included in Table 3 due to common requests.

Table 4. Internal Standards

Analyte	Accuracy (% R)
Bromochloromethane	60 – 140
1,4-Difluorobenzene	60 – 140
Chlorobenzene-d_5	60 – 140

Table 5. Surrogates

Analyte	Accuracy (% R)
1,2-Dichloroethane-d_4	70 – 130
Toluene-d_8	70 – 130
4-Bromofluorobenzene	70 – 130

Table 6. Summary of Calibration and QC Procedures for Methods TO-14A/TO-15 Low-Level

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Every 24 hours	TO-15 ion abundance criteria	Correct problem then repeat tune.
Minimum 5-Point Initial Calibration (ICAL)	Prior to sample analysis	% RSD ≤ 30 with 4 compounds allowed out to ≤ 40% RSD	Correct problem then repeat Initial Calibration curve.
Initial Calibration Verification and Laboratory Control Spike (ICV and LCS)	After each Initial Calibration curve, and daily prior to sample analysis	Recoveries for 85% of Standard compounds must be 70–130%. No recovery may be < 50%. If specified by the client, in-house generated control limits may be used.	Check the system and re-analyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.
Initial Calibration Verification and Laboratory Control Spike (ICV and LCS) for Non-standard Compounds	Per client request or specific project requirements only	Recoveries of compounds must be 60–140%. No recovery may be <50%.	Check the system and re-analyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.
Continuing Calibration Verification (CCV) for Standard compounds	At the start of each analytical clock after the tune check	70–130%	Compounds exceeding this criterion and associated data will be flagged and narrated with the exception of high bias associated with non-detects. If more than 4 compounds from the standard list recover outside of 70–130%, corrective action will be taken. If any compound exceeds 60–140%, samples are not analyzed unless data meets project needs. Check the system and re-analyze the standard. Re-prepare the standard if necessary. Re-calibrate the instrument if the criteria cannot be met.
Continuing Calibration Verification (CCV) for Non-Standard compounds	Per client request or specific project requirements only	Recoveries of compounds must be 60–140%. No recovery may be <50%.	Check the system and re-analyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.

Laboratory Blank	After analysis of standards and prior to sample analysis, or when contamination is present	Results less than the laboratory reporting limit	Inspect the system and re-analyze the blank. "B"-flag data for common contaminants.
Internal Standard (IS)	As each standard, blank, and sample is being loaded	Retention time (RT) for blanks and samples must be within ±0.33 min of the RT in the CCV and within ± 40% of the area counts of the daily CCV internal standards.	**For blanks:** Inspect the system and reanalyze the blank. **For samples:** Re-analyze the sample unless obvious matrix interference is documented. If the ISs are within limits in the re-analysis, report the second analysis. If ISs are out-of-limits a second time, report data from first analysis and narrate.
Surrogates	As each standard, blank, and sample is being loaded	70–130% R If specified by the client, in-house generated control limits may be used.	**For blanks:** Inspect the system and re-analyze the blank **For samples:** Re-analyze the sample unless obvious matrix interference is documented. If the %Rs are within limits in the re-analysis, report the second analysis. If %Rs are out-of-limits a second time, report data from first analysis and narrate.
Laboratory Duplicates - Laboratory Control Spike Duplicate (LCSD)	One per analytical batch	RPD ≤25%	Narrate exceedances. If more than 5% of compound list is outside criteria or if compound is >40% RPD, investigate the cause and perform maintenance as required. If instrument maintenance is required, calibrate as needed.

ANALYTICAL METHODS

Section 14.0

Method: EPA Method TO-14A/TO-15 Volatile Organic Compounds (5&20)

Eurofins Air Toxics SOP #91 Revision 5 Effective Date: January 14, 2013 Methods Manual Summary

Description: This method involves full scan gas chromatograph/mass spectrometer (GC/MS) analysis of whole air samples collected in evacuated stainless steel canisters. Samples are analyzed for volatile organic compounds (VOCs) using EPA Method TO-14A/TO-15 protocols. An aliquot of up to 0.05 liters of air is withdrawn from the canister utilizing a volumetric syringe or mass flow controller. This volume is loaded onto a hydrophobic multibed sorbent trap to remove water and carbon dioxide and to concentrate the vapor sample. The focused sample is then flash-heated to sweep adsorbed VOCs onto a secondary trap for further concentration and/or onto a GC/MS for separation and detection.

Eurofins Air Toxics maintains a suite of TO-14A/TO-15 methods, each optimized to efficiently meet the data objectives for a wide range of targeted concentration ranges. The methods, their reporting limits, and typical applications are summarized in the table below. This method summary describes TO-14A/TO-15 (5&20). The 5&20 analytical configuration is designed to directly measure ppmv concentrations with minimal offline dilutions due to its wide dynamic calibration range.

Eurofins Air Toxics Method	Base Reporting Limits	Typical Application
TO-14A/TO-15 (5&20)	5 – 20 ppbv	Soil gas and ppmv range vapor matrices
TO-14A/TO-15 (Standard or Quad)	0.5 – 5.0 ppbv	Ambient air, soil gas, and ppbv level vapor matrices
TO-14A/TO-15 (Low-level)	0.1 – 0.5 ppbv	Indoor and outdoor air
TO-14A/TO-15 SIM	0.003 – 0.5 ppbv	Indoor and outdoor air

Certain compounds are not included in Eurofins Air Toxics' standard target analyte list. These compounds are communicated at the time of client proposal request. Unless otherwise directed, Eurofins Air Toxics reports these non-routine compounds with partial validation. Validation may include a 3-point calibration with the lowest concentration defining the reporting limit, no second source verification analyzed, and no method detection limit study performed unless previous arrangements have been made. In addition, stability of the non-standard compound during sample storage is not validated. Full validation may be available upon request.

Eurofins Air Toxics takes no modifications of technical significance to Method TO-15 for the "5&20" configuration. Since Eurofins Air Toxics applies TO-15 methodology to all Summa canisters regardless of whether TO-14A or TO-15 is specified by the project, the laboratory performs a modified version of method TO-14A as detailed in Table 1. Please note that Methods TO-14A and TO-15 were validated for specially treated canisters. As such, the use of Tedlar bags for sample collection is outside the scope of the method and not recommended for ambient air samples. It is the responsibility of the data user to determine the usability of TO-14A and TO-15 results generated from Tedlar bags.

Table 1. Summary of TO-14A Method Modifications

Requirement	TO-14A	ATL Modifications
Sample Drying System	Nafion Drier	Multibed hydrophobic sorbent
Blank acceptance criteria	< 0.2 ppbv	< RL
BFB ion abundance criteria	Ion abundance criteria listed in Table 4 of TO-14A	Follow abundance criteria listed in TO-15
BFB absolute abundance criteria	Within 10% when comparing to the previous daily BFB	CCV internal standard area counts are compared to ICAL; corrective action when recovery is less than 60%.
Initial Calibration	≤ 30% RSD for listed 39 VOCs	≤ 30% RSD with 2 of Eurofins Air Toxics' 62 standard compounds allowed out to ≤ 40%

The standard target analyte list, reporting limit (RL), also referred to as Limit of Quantitation (LOQ), QC criteria, and QC summary can be found in Tables 2 through 5.

Table 2. Method TO-14A/TO-15 Analyte List (5&20)

Analyte	RL/LOQ (ppbv)	QC Acceptance Criteria			
		ICAL (%RSD)	CCV (%R)	ICV/LCS (%R)	Precision Limits (Max. RPD)
1,1,2,2-Tetrachloroethane	5.0	≤ 30%	70 – 130	70 – 130	± 25
1,1,2-Trichloroethane	5.0	≤ 30%	70 – 130	70 – 130	± 25
1,1-Dichloroethane	5.0	≤ 30%	70 – 130	70 – 130	± 25
1,1-Dichloroethene	5.0	≤ 30%	70 – 130	70 – 130	± 25
1,2,4-Trichlorobenzene	20	≤ 30%	70 – 130	70 – 130	± 25
1,2,4-Trimethylbenzene	5.0	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dibromoethane (EDB)	5.0	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dichlorobenzene	5.0	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dichloroethane	5.0	≤ 30%	70 – 130	70 – 130	± 25
1,2-Dichloropropane	5.0	≤ 30%	70 – 130	70 – 130	± 25
1,3,5-Trimethylbenzene	5.0	≤ 30%	70 – 130	70 – 130	± 25
1,3-Dichlorobenzene	5.0	≤ 30%	70 – 130	70 – 130	± 25
1,4-Dichlorobenzene	5.0	≤ 30%	70 – 130	70 – 130	± 25
Benzene	5.0	≤ 30%	70 – 130	70 – 130	± 25
Bromomethane*	5.0	≤ 30%	70 – 130	70 – 130	± 25
Carbon Tetrachloride	5.0	≤ 30%	70 – 130	70 – 130	± 25
Chlorobenzene	5.0	≤ 30%	70 – 130	70 – 130	± 25
Chloroethane	20	≤ 30%	70 – 130	70 – 130	± 25

Dibromochloromethane	5.0	≤ 30%	70 – 130	70 – 130	± 25
Chloroform	5.0	≤ 30%	70 – 130	70 – 130	± 25
Chloromethane	20	≤ 30%	70 – 130	70 – 130	± 25
Chlorotoluene (Benzyl Chloride)	5.0	≤ 30%	70 – 130	70 – 130	± 25
cis-1,2-Dichloroethene	5.0	≤ 30%	70 – 130	70 – 130	± 25
cis-1,3-Dichloropropene	5.0	≤ 30%	70 – 130	70 – 130	± 25
Dichloromethane (Methylene Chloride)	5.0	≤ 30%	70 – 130	70 – 130	± 25
Ethylbenzene	5.0	≤ 30%	70 – 130	70 – 130	± 25
Freon 11 (Trichlorofluoromethane)	5.0	≤ 30%	70 – 130	70 – 130	± 25
Freon 113 (Trichlorotrifluoroethane)	5.0	≤ 30%	70 – 130	70 – 130	± 25
Freon 114	5.0	≤ 30%	70 – 130	70 – 130	± 25
Freon 12 (Dichlorodifluoromethane)	5.0	≤ 30%	70 – 130	70 – 130	± 25
Hexachlorobutadiene	20	≤ 30%	70 – 130	70 – 130	± 25
m,p-Xylene	5.0	≤ 30%	70 – 130	70 – 130	± 25
Methyl Chloroform (1,1,1-Trichloroethane)	5.0	≤ 30%	70 – 130	70 – 130	± 25
o-Xylene	5.0	≤ 30%	70 – 130	70 – 130	± 25
Styrene	5.0	≤ 30%	70 – 130	70 – 130	± 25
Tetrachloroethene	5.0	≤ 30%	70 – 130	70 – 130	± 25
Toluene	5.0	≤ 30%	70 – 130	70 – 130	± 25
trans-1,3-Dichloropropene	5.0	≤ 30%	70 – 130	70 – 130	± 25
Trichloroethene	5.0	≤ 30%	70 – 130	70 – 130	± 25
Vinyl Chloride	5.0	≤ 30%	70 – 130	70 – 130	± 25
1,3-Butadiene	5.0	≤ 30%	70 – 130	70 – 130	± 25
1,4-Dioxane	20	≤ 30%	70 – 130	70 – 130	± 25
2-Butanone (Methyl Ethyl Ketone)	20	≤ 30%	70 – 130	70 – 130	± 25
2-Hexanone	20	≤ 30%	70 – 130	70 – 130	± 25
4-Ethyltoluene	5.0	≤ 30%	70 – 130	70 – 130	± 25
4-Methyl-2-Pentanone (MIBK)	5.0	≤ 30%	70 – 130	70 – 130	± 25
Acetone	20	≤ 30%	70 – 130	70 – 130	± 25
Bromodichloromethane	5.0	≤ 30%	70 – 130	70 – 130	± 25
Bromoform	5.0	≤ 30%	70 – 130	70 – 130	± 25
Carbon Disulfide	5.0	≤ 30%	70 – 130	70 – 130	± 25
Cyclohexane	5.0	≤ 30%	70 – 130	70 – 130	± 25

Dibromochloromethane	5.0	≤ 30%	70 – 130	70 – 130	± 25
Ethanol	20	≤ 30%	70 – 130	70 – 130	± 25
Heptane	5.0	≤ 30%	70 – 130	70 – 130	± 25
Hexane	5.0	≤ 30%	70 – 130	70 – 130	± 25
Isopropanol	20	≤ 30%	70 – 130	70 – 130	± 25
Methyl t-Butyl Ether (MTBE)	5.0	≤ 30%	70 – 130	70 – 130	± 25
Tetrahydrofuran	5.0	≤ 30%	70 – 130	70 – 130	± 25
trans-1,2-Dichloroethene	5.0	≤ 30%	70 – 130	70 – 130	± 25
2,2,4-Trimethylpentane	5.0	≤ 30%	70 – 130	70 – 130	± 25
Cumene	5.0	≤ 30%	70 – 130	70 – 130	± 25
Propylbenzene	5.0	≤ 30%	70 – 130	70 – 130	± 25
3-Chloroprene	20	≤ 30%	70 – 130	70 – 130	± 25
Naphthalene**	20	≤ 40%	60 – 140	60 – 140	± 25
TPH (Gasoline) ***	100	1- Point Calibration	NA	ICV only: 60 – 140	± 25
NMOC (Hexane/Heptane)***	100	1- Point Calibration	NA	NA	± 25

*Bromomethane recovery can be variable due to moisture/sorbent interactions specifically on the 2-trap concentration system. Data may require qualifier flags.

**Due to its low vapor pressure, Naphthalene may exceed TO-15 performance requirements. The wider QC limits reflect typical performance. Although Naphthalene is not on Eurofins Air Toxics "standard" TO-15 list, it is commonly requested and included in Table 2.

***TPH and NMOC are not on Eurofins Air Toxics' "standard" TO-15 list, but are included in Table 2 due to common requests.

Table 3. Internal Standards

Analyte	Accuracy (% R)
Bromochloromethane	60 – 140
1,4-Difluorobenzene	60 – 140
Chlorobenzene-d_5	60 – 140

Table 4. Surrogates

Analyte	Accuracy (% R)
1,2-Dichloroethane-d_4	70 – 130
Toluene-d_8	70 – 130
4-Bromofluorobenzene	70 – 130

Table 5. Summary of Calibration and QC Procedures for Methods TO-14A/TO-15 (5&20)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Every 24 hours.	TO-15 ion abundance criteria	Correct problem then repeat tune.
Minimum 5-Point Initial Calibration (ICAL)	Prior to sample analysis.	% RSD ≤ 30 with 2 compounds allowed out to ≤ 40% RSD	Correct problem then repeat Initial Calibration Curve.
Initial Calibration Verification and Laboratory Control Spike (ICV and LCS)	After each Initial Calibration curve, and daily prior to sample analysis	Recoveries for 85% of "Standard" compounds must be 70-130%. No recovery may be <50%. If specified by the client, in-house generated control limits may be used.	Check the system and reanalyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.
Initial Calibration Verification and Laboratory Control Spike (ICV and LCS) for Non-standard compounds	Per client request or specific project requirements only.	Recoveries of compounds must be 60–140%. No recovery may be <50%.	Check the system and reanalyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.
Continuing Calibration Verification (CCV)	At the start of each analytical clock after the tune check.	70–130%	Compounds exceeding this criterion and associated data will be flagged and narrated with the exception of high bias associated with non-detects. If more than two compounds from the standard list recover outside of 70-130%, corrective action will be taken. If any compound exceeds 60-140%, samples are not analyzed unless data meets project needs. Check the system and reanalyze the standard. Re-prepare the standard if necessary. Re-calibrate the instrument if the criteria cannot be met.
Laboratory Blank	After analysis of standards and prior to sample analysis, or when contamination is present.	Results less than the laboratory reporting limit	Inspect the system and re-analyze the blank. "B"-flag data for common contaminants.
Internal Standard (IS)	As each standard, blank, and sample is being loaded	Retention time (RT) for blanks and samples must be within ±0.33 min of the RT in the CCV and within ±40% of the area counts of the daily CCV internal standards.	**For blanks:** Inspect the system and reanalyze the blank. **For samples:** Re-analyze the sample. If the ISs are within limits in the re-analysis, report the second analysis. If ISs are out-of-limits a second time, dilute the sample until ISs are within acceptance limits and narrate.

Surrogates	As each standard, blank, and sample is being loaded.	70–130% If specified by the client, in-house generated control limits may be used.	**For blanks:** Inspect the system and reanalyze the blank. **For samples:** re-analyze the sample unless obvious matrix interference is documented. If the %Rs are within limits in the re-analysis, report the second analysis. If %Rs are out-of-limits a second time, report data from first analysis and narrate.
Laboratory Duplicates – Laboratory Control Spike Duplicates (LCSD)	One per analytical batch	RPD ≤25%	Narrate exceedances. If more than 5% of compound list is outside criteria or if compound has >40%RPD, investigate the cause and perform maintenance as required. If instrument maintenance is required, calibrate as needed.

ANALYTICAL METHODS

Section 15.0

Method: TO-15 Aliphatic and Aromatic Volatile Petroleum Hydrocarbons (VPH) Fractions by GC/MS

Eurofins Air Toxics SOP #103 Revision 5 Effective Date: January 29, 2014 Methods Manual Summary

Description: The TO-15 VPH method outlines procedures to estimate the concentrations of gaseous phase Aliphatic and Aromatic ranges in ambient air and soil gas collected in stainless steel Summa canisters. The volatile Aliphatic hydrocarbons are collectively quantified within the C5 to C6 range, C6 to C8 range, C8 to C10 range, and the C10 to C12 range. Additionally, the volatile Aromatic hydrocarbons are collectively quantified within the C8 to C10 range and the C10 to C12 range. The Aromatic ranges refer to the equivalent carbon (EC) ranges.

Data is acquired using standard TO-15 GC/MS instrumentation. Procedures are largely based on the hydrocarbon ranges and calibration reference compounds defined by the Washington State Department of Ecology (WSDE) Method for the Determination of Volatile Petroleum Hydrocarbons (VPH) Fractions, dated June 1997. Additionally, the WSDE VPH calibration and quantitation procedures for the Aromatic fraction have been enhanced to more effectively isolate the compounds of interest. The Aromatic fraction measurement is based on a modification of the Massachusetts Department of Environmental Protection (MADEP) Air Phase Hydrocarbon Method (2009).

Eurofins Air Toxics performs a modified version of this method. The method modifications, standard target analyte list, reporting limit (RL) or Limit of Quantitation (LOQ), QC criteria, and QC summary can be found in the following tables.

Table 1. Summary of Method Modifications for TO-15 VPH

Requirement	VPH	Eurofins Air Toxics Modifications
Detector	Tandem GC/FID/PID	GC/MS
Matrix	Soil, water, and sediments	Whole air samples
C6-C8 Reference Compound	Octane	Heptane
Surrogate	2,5-Dibromotoluene	Bromochloromethane, 1,2-Dichloroethane-d4, Toluene-d8, Chlorobenzene-d5, and 4-Bromofluorobenzene
%RSD for Reference Compounds	≤ 20% RSD	≤ 30% RSD with the exception of Decane, Dodecane, 1,2,4,5-Tetramethylbenzene, and Naphthalene at ≤ 40% RSD
%D for the CCV	±20%D	±30%D with the exception of Decane, Dodecane, 1,2,4,5-Tetramethylbenzene, and Naphthalene at ±40%D

Laboratory Control Spike	Matrix Spiking Solution	Independently prepared source performed after initial calibration, 70–130% recovery, with the exception of Decane, Dodecane,1,2,4,5-Tetramethylbenzene, and Naphthalene at 60–140%
CCV Frequency	Before and after every 10 samples	Daily before sample analysis
IDOC	4 Replicates of a CCV at ±20%D; %RSD ≤ 20%	Not performed for this method; TO-15 IDOC performed on the same instrument

Table 2. VPH Standard Target Analyte List (Note: TO-15 analytes can also be included.)

Analyte	Standard RL (ppbv)	5&20 RL (ppbv)	Acceptance Criteria		
			ICAL %RSD	ICV (%R)	CCV (%D)
Pentane	NA	NA	≤ 30%	70-130	≤ 30%
Hexane	NA	NA	≤ 30%	70-130	≤ 30%
C_5-C_6 Aliphatics Pentane + Hexane	**10**	**50**	**≤ 30%**	**70-130**	**≤ 30%**
C_6-C_8 Aliphatics ref. to Heptane	**10**	**50**	**≤ 30%**	**70-130**	**≤ 30%**
C_8-C_{10} Aliphatics ref. to Decane	**10**	**50**	**≤ 40%**	**60-140**	**≤ 40%**
C_{10}-C_{12} Aliphatics ref. to Dodecane	**10**	**50**	**≤ 40%**	**60-140**	**≤ 40%**
Ethyl benzene	2	10	≤ 30%	70-130	≤ 30%
m/p-Xylene	2	10	≤ 30%	70-130	≤ 30%
o-Xylene	2	10	≤ 30%	70-130	≤ 30%
1,2,3-Trimethylbenzene	NA	NA	≤ 30%	70-130	≤ 30%
C_8-C_{10} Aromatics	**10**	**50**	**≤ 30%**	**70-130**	**≤ 30%**
Naphthalene	2	10	≤ 40%	60-140	≤ 40%
1,2,4,5-Tetramethylbenzene	NA	NA	≤ 40%	60-140	≤ 40%
C_{10}-C_{12} Aromatics	**10**	**50**	**≤ 40%**	**60-140**	**≤ 40%**

Table 3. Internal Standard Acceptance Criterion – Aliphatic Fraction

Analyte	Recovery Limits (%R)
1,4-Difluorobenzene	50 – 200%

Table 4. Internal Standard Acceptance Criterion – Aromatic Fraction

Analyte	Recovery Limits (%R)
Chlorobenzene-d_5	60 – 140%

Table 4. Summary of Calibration and QC Procedures

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Every 24 hours	Compendium of Methods for Toxic Organic Air Pollutants, Method TO-15, January 1999	Correct problem then repeat tune.
6-Point Initial Calibration (ICAL)	Prior to sample analysis	%RSD ≤ 30% for VPH Target Analyte List with exceptions for 1,2,4,5-Tetramethylbenzene and Naphthalene, which are ≤40%	Correct problem then repeat initial calibration curve.
Initial Calibration Verification (ICV)	After each initial calibration curve	Recoveries for VPH target compounds 70–130%, or 60–140% for 1,2,4,5-Tetramethylbenzene and Naphthalene. If recovery of any compound is above 130%, analyze samples as long as compound is not detected.	Check the system and re-analyze the standard. Re-prepare the standard if necessary. Re-calibrate the instrument if the criteria cannot be met.
Continuing Calibration Verification (CCV)	At the start of each analytical clock after the tune check	%D ≤ 30% for VPH target compounds with exceptions for 1,2,4,5-Tetramethylbenzene and Naphthalene, which are <40%. One compound is allowed to be out as long as it is ≤ 50%D. If recovery of any compound is above 150% the instrument must be re-calibrated.	Perform maintenance and repeat test. If the CCV still fails, perform maintenance and a new 6-point calibration curve.
Laboratory Blank	After the CCV	Results less than the laboratory RL	Inspect the system and re-analyze the blank.
Internal Standard (IS)	As each standard, blank, and sample is being loaded.	Retention time (RT) for the blanks and samples must be within ±0.33 min of the RT in the CCV. For the aliphatic fraction using the total ion area, the IS area must be within -50% to 200% of the CCV's IS area for the blanks and samples. For the aromatic fraction using extracted ion areas, the IS area must be within -40% to +40% of the CCV's extracted ion IS area.	**For blanks:** Inspect the system and re-analyze the blank **For samples:** If there is not obvious interference with the internal standard, re-analyze the sample. If the ISs are within limits in the re-analysis, report the second analysis. Dilution of the sample to get IS areas within limits may be used if the RL is being obtained.
Laboratory Duplicates	One per analytical batch; since VPH analysis occurs with TO-15 analysis, the Duplicate is reported from the daily TO-15 LCS/LCSD pair. The result is not reported with the VPH fraction.	RPD ≤ 25% for detections >5X the RL	Re-analyze the sample a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found with the system, narrate.

ANALYTICAL METHODS

Section 16.0

Method: Modified EPA TO-17 VOCs and SVOCs (Vapor Intrusion Application) by GC/MS (Full Scan)

Eurofins Air Toxics SOP #109 Revision 4 Effective Date: December 24, 2013 Methods Manual Summary

Description: The TO-17 "Vapor Intrusion" method utilizes a multi-bed thermal desorption tube for the measurement of air-phase Volatile Organic Compounds (VOCs) and Polycyclic Aromatic Hydrocarbons (PAHs). These tubes are marketed by Eurofins Air Toxics as "TO-17 VI" tubes. The TO-17 VI tubes are applicable to a wide variety of vapor matrices including soil gas, indoor air, and outdoor air. Parameters are optimized to effectively manage high humidity conditions. The TO-17 VI method is an alternative to the canister-based sampling and analysis methods that are presented in EPA Compendium Methods TO-14A and TO-15 as well as an alternative to PUF/XAD sampling for semi-volatile compounds as described by EPA Compendium TO-13A. The VI tube provides sufficient retention of light VOCs such as 1,3-Butadiene while providing an efficient desorption of semi-volatile compounds such as Pyrene.

Samples are collected by drawing a measured volume of air through the VI sorbent tubes. Collection is performed using a low-flow vacuum pump or a volumetric syringe attached to the outlet side of the tube. Analysis is accomplished by heating the sorbent tube and sweeping the desorbed compounds onto a secondary "cold" trap for water management and analyte refocusing. The secondary trap is heated for efficient transfer of compounds onto the gas chromatograph (GC) for separation followed by detection using mass spectrometry (MS).

Certain compounds are not included in Eurofins Air Toxics' standard target analyte list. These compounds are communicated at the time of client proposal request. Unless otherwise directed, the laboratory reports these non-standard compounds with partial validation. Validation includes a 3-point calibration with the lowest concentration defining the reporting limit, no second source verification is analyzed, and no method detection limit study is performed unless previous arrangements have been made. In addition, stability of the non-standard compounds during sample storage, safe sampling volume, and desorption efficiency are not validated. Full validation may be available upon request.

Since the TO-17 VI application significantly extends the scope of target compounds addressed in EPA Method TO-15 and TO-17, the laboratory has implemented several method modifications as outlined in Table 1.

Table 1. EPA TO-17 Method Modifications – VI Application

Requirement	TO-17	Eurofins Air Toxics Modifications
Initial Calibration	%RSD ≤ 30% with 2 allowed out up to 40%	For the VOC list: %RSD ≤ 30% with 2 allowed out up to 40% For the PAH list: %RSD ≤ 30% with 2 allowed out up to 40%
Daily Calibration	%D for each target compound within ±30%.	Fluorene, Phenanthrene, Anthracene, Fluoranthene, and Pyrene within ±40%D
Audit Accuracy	70 – 130%	Second source recovery limits for Fluorene, Phenanthrene, Anthracene, Fluoranthene, and Pyrene = 60 – 140%
Distributed Volume Pairs	Collection of distributed volume pairs required for monitoring ambient air to ensure high quality.	If the client is sampling well-characterized air or has verified performance through previous sampling or distributed pairs, single tube sampling may be appropriate. Distributed volume pairs may not be practical or useful for soil vapor collection due to required configuration and volume constraints.

Table 2. Method TO-17 VI Standard Analyte List and QC Limits

Volatile Organic Compounds	Reporting Limit (ng)	QC Acceptance Criteria			
		ICAL (%RSD)	ICV (%R)	CCV (%D)	LCS (%R)
Freon 114	14	30	70 – 130	30	70 – 130
Vinyl Chloride	2.6	30	70 – 130	30	70 – 130
1,3-Butadiene	2.2	30	70 – 130	30	70 – 130
Isopentane	5.9	30	70 – 130	30	70 – 130
Freon 11	11	30	70 – 130	30	70 – 130
1,1-Dichloroethene	4.0	30	70 – 130	30	70 – 130
Methylene Chloride	21	30	70 – 130	30	70 – 130
Freon 113	7.7	30	70 – 130	30	70 – 130
Trans-1,2-Dichloroethene	4.0	30	70 – 130	30	70 – 130
1,1-Dichloroethane	4.0	30	70 – 130	30	70 – 130
cis-1,2-Dichloroethene	4.0	30	70 – 130	30	70 – 130
Hexane	35	30	70 – 130	30	70 – 130
Chloroform	4.9	30	70 – 130	30	70 – 130
1,2-Dichloroethane	4.0	30	70 – 130	30	70 – 130
1,1,1-Trichloroethane	5.4	30	70 – 130	30	70 – 130
Benzene	6.4	30	70 – 130	30	70 – 130
Carbon Tetrachloride	6.3	30	70 – 130	30	70 – 130

Cyclohexane	6.9	30	70 – 130	30	70 – 130
1,2-Dichloropropane	4.6	30	70 – 130	30	70 – 130
Trichloroethene	5.4	30	70 – 130	30	70 – 130
1,4-Dioxane	11	30	70 – 130	30	70 – 130
2,2,4-Trimethylpentane	9.4	30	70 – 130	30	70 – 130
Heptane	8.2	30	70 – 130	30	70 – 130
Methylcyclohexane	8.0	30	70 – 130	30	70 – 130
1,1,2-Trichloroethane	5.4	30	70 – 130	30	70 – 130
Methyl isobutyl ketone	8.2	30	70 – 130	30	70 – 130
Toluene	7.5	30	70 – 130	30	70 – 130
Methylbutylketone	8.2	30	70 – 130	30	70 – 130
Tetrachloroethene	6.8	30	70 – 130	30	70 – 130
Chlorobenzene	4.6	30	70 – 130	30	70 – 130
Ethylbenzene	4.3	30	70 – 130	30	70 – 130
M,p-xylene	8.7	30	70 – 130	30	70 – 130
o-Xylene	8.7	30	70 – 130	30	70 – 130
Styrene	8.5	30	70 – 130	30	70 – 130
1,1,2,2-Tetrachloroethane	6.9	30	70 – 130	30	70 – 130
Cumene	9.8	30	70 – 130	30	70 – 130
n-Propylbenzene	9.8	30	70 – 130	30	70 – 130
4-Ethyltoluene	9.8	30	70 – 130	30	70 – 130
1,3,5-Trimethylbenzene	9.8	30	70 – 130	30	70 – 130
1,2,4-Trimethylbenzene	29	30	70 – 130	30	70 – 130
1,3-Dichlorobenzene	6.0	30	70 – 130	30	70 – 130
1,4-Dichlorobenzene	6.0	30	70 – 130	30	70 – 130
1,2-Dichlorobenzene	6.0	30	70 – 130	30	70 – 130
1,2,4-Trichlorobenzene	15	30	70 – 130	30	70 – 130
Hexachlorobutadiene	21	30	70 – 130	30	70 – 130
Chloroethane†	16	30	70 – 130	30	70 – 130
Isopropyl alcohol†	49	30	70 – 130	30	70 – 130
Carbon Disulfide†	6.2	30	70 – 130	30	70 – 130
MTBE†‡	22	30	70 – 130	30	70 – 130
Methyl Ethyl Ketone†	59	30	70 – 130	30	70 – 130

Polyaromatic Hydrocarbons	Reporting Limit (ng)	ICAL (%RSD)	ICV (%R)	CCV (%D)	LCS (%R)
Naphthalene	0.5	30	70 – 130	30	70 – 130
2-Methylnaphthalene	1.0	30	70 – 130	30	70 – 130
1-Methylnaphthalene	1.0	30	70 – 130	30	70 – 130
Acenaphthylene	5.0	30	70 – 130	30	70 – 130
Acenaphthene	5.0	30	70 – 130	30	70 – 130
Fluorene	5.0	30	60 – 140	40	60 – 140
Phenanthrene	5.0	30	60 – 140	40	60 – 140
Anthracene	5.0	30	60 – 140	40	60 – 140
Fluoranthene	5.0	30	60 – 140	40	60 – 140
Pyrene	5.0	30	60 – 140	40	60 – 140

†Non-routine compounds by special request only.
‡Poor recovery performance when dry purge is applied for sample collection volumes greater than 1 Liter.

Table 3. Commonly requested TPH parameters – Optional

TPH	Reporting Limit (ng)	ICAL (%RSD)	ICV (%R)	CCV (%D)	LCS (%R)
GRO (Gasoline Range)	1000	30	60-140	30	60 – 140
DRO (C10-C24 Diesel Range)	1000	30	60-140	30	60 – 140

Table 4. Internal Standard and Field Surrogate Recoveries

Internal Standards		
Analyte	**CCV IS % Recovery**	**Sample IS % Recovery**
Bromochloromethane	60 – 140	60 – 140
1,4-Difluorobenzene	60 – 140	60 – 140
Chlorobenzene-d_5	60 – 140	60 – 140
Bromofluorobenzene	60 – 140	60 – 140
Field Surrogates		
Analyte	**% Recovery**	
1,2-Dichloroethane-d4	50 – 150	
Toluene-d8	50 – 150	
Naphthalene-d8	50 – 150	

Table 5. Summary of Calibration and QC Procedures for Modified Method TO-17 VI

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
BFB Tune Check	Before initial and daily calibration. Check is valid for 24 hours.	TO-15 tune criteria	Correct problem then repeat tune.
5-Point Calibration	Prior to sample analysis	%RSD $\leq$ 30% with 2 VOCs exceeding up to 40% RSD and 2 PAHS exceeding criteria up to 40%RSD.	Correct problem then repeat Initial Calibration Curve.
Initial Calibration Verification (ICV)	After each initial Calibration Curve	See Table 2; 20% of the compounds are allowed to exceed criterion.	Determine if the exceedance is due to an inaccurate calibration standard or inaccurate ICV standard. Recalibrate with an accurate standard or re-prepare the ICV as necessary. If any VOC exceeds 50–150% recovery, system is checked and the ICV is reanalyzed. For compounds with recoveries greater than 150% and no positive detections in the samples, approval to proceed will be granted on a case-by-case basis.
Continuing Calibration Verification (CCV)	At the start of each 24-hour clock after the Tune Check	70 – 130% 60–140% for Fluorene, Phenanthrene, Anthracene, Fluoranthene and Pyrene	If project-specified risk drivers exceed these criteria, more than 5% of the compounds exceed these criteria, or any VOC exceeds 50–150% recovery, maintenance is performed and the CCV test repeated. If the system still fails the CCV, perform a new 5-point Calibration Curve.
Laboratory Blank	After the CCV and before the samples and at end of sequence	Results less than the laboratory RL for Lab Blank analyzed prior to samples	Inspect the system and re-analyze the Blank. Flag associated data as appropriate.
Laboratory Control Spike (LCS)	Once per analytical batch	70 – 130% 60–140% for Fluorene, Phenanthrene, Anthracene, Fluoranthene and Pyrene; 20% of compound list may exceed criteria before corrective action is required.	Verify accuracy of standard. Re-prepare LCS if necessary. If calibration curve and/or system is found to be out of control, perform maintenance and re-calibrate. If any VOC exceeds 50–150% recovery, maintenance is performed and the ICV test is repeated. For compounds with recoveries greater than 150% and no positive detections in the samples, approval to proceed will be granted on a case-by-case basis.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Laboratory Control Spike Duplicate (LCSD)	Once per analytical batch (reanalysis of LCS)	≤ 20% RPD	Verify accuracy of standard. Re-prepare LCS if necessary. If calibration curve and/or system is found to be out of control, perform maintenance and re-calibrate. If any VOC exceeds 50–150% recovery, maintenance is performed and the ICV test is repeated. For compounds with recoveries greater than 150% and no positive detections in the samples, approval to proceed will be granted on a case-by-case basis.
Internal Standard (IS)	As each QC sample and sample are being loaded	**CCVs:** Area counts > 60% recovery; Retention Time (RT) within 20 seconds of mid-point in ICAL. **Blanks and samples**: Retention time (RT) must be within ±0.33 minutes of the RT in the CCV. The IS area must be within ±40% of the CCV's IS area for the Blanks and samples.	**CCV:** Inspect and correct system prior to sample analysis. **Blanks:** Inspect the system and re-analyze the Blank. **Samples:** Investigate the problem by verifying the instrument is in control by running a Lab Blank. Re-analyze recollected samples to verify recovery. Report the run with acceptable IS recovery. If both runs are unacceptable, narrate and flag associated data.
Field Surrogates	Added to each tube prior to shipment to field. Added to QC samples prior to analysis.	50–150%	**For blanks:** Inspect the system and re-analyze the Blank. **For samples:** Review data to determine whether sample collection parameters or matrix interference resulted in the exceedances. If so, narrate and flag recovery. If no cause is evident, verify the instrument is in control by running a Lab Blank. Re-analyze recollected sample to verify recovery.
Field Blank	Project-dependent	Artifact levels should be less than the reporting limit or less than 10% of the mass measured on the sampled tubes, whichever is less.	Flag associated results and evaluate tube conditioning and storage procedures.
Distributed Pairs	Project-dependent	%RPD ≤ 25%	Narrate discrepancy.

ANALYTICAL METHODS

Section 17.0

Method: ANALYSIS OF VOCS BY GC/MS COLLECTED ON CHARCOAL-BASED PASSIVE SAMPLERS

Eurofins Air Toxics SOP #100 Revision 4 Effective Date: January 10, 2014 Methods Manual Summary

Description: This method involves gas chromatograph/mass spectrometer (GC/MS) analysis of volatile organic compounds (VOCs) collected using charcoal-based passive samplers. These passive samplers include the Radiello® 130, SKC badges (575 and Ultra series), 3M™ OVM badges, and the WMS™ permeation sampler. Passive samplers are used to measure vapor-phase VOCs in a variety of gaseous matrices including indoor air, outdoor air, extracted soil gas, and emissions from materials. VOCs in the sampling environment pass through the diffusive barrier or permeable membrane of the sampler at a known, controlled rate (defined as the sampling rate) and adsorb to the charcoal-based sorbent pad of the sampler. The sorbent is extracted using a volume of carbon disulfide, and the extract is directly injected into a GC equipped with an MS. The retention time and spectral pattern of a compound are compared with that of known standard. Concentrations of the analytes are calculated from the average relative response factors of calibration curves obtained from analysis of standard solutions. The results are reported in units of µg/sample or µg/m^3 if the sampling rate and duration is known. Results for subsurface soil gas measurements are typically reported in units of µg/sample since there may be a low bias in the calculated µg/m^3 concentration due to starvation effects. Starvation effects occur when the uptake rate of the sampler exceeds the delivery rate of vapors from the surrounding soil.

There are no regulatory methods for the preparation and analysis of the Radiello and WMS samplers, while OSHA methods are available for workplace exposure measurements for several of the VOCs using 3M OVM 3500 and SKC 575 series samplers. The OSHA methods and recommended procedures published by Radiello (FSM) and 3M serve as the basis for this standard operating procedure for the analysis of environmental samples. Additionally, QC elements outlined in EPA SW-846 8260 and 8270 are incorporated as applicable. One variance of note that Eurofins Air Toxics has taken to the OSHA, Radiello, and the OVM 3500 methods is the use of GC/MS instead of GC/FID, thus providing more definitive compound identification and quantification for trace level environmental measurements.

Table 1 lists the target analytes routinely calibrated, along with the extract reporting limits and QC acceptance criteria. Tables 4 through 6 list the reporting limit for each sampler type in units of mass and the sampling rate. The sampling rates for the WMS sampler are maintained as proprietary and are not published as part of this document. To calculate the sample reporting limit in terms of µg/m^3, the compound sampling rate and the sample duration are required. Please consult with the laboratory to determine the appropriate sampler to meet project objectives.

Table1. Target Analytes, (Extract) Reporting Limits, and QC Criteria

Analytes	Reporting Limit (µg/mL)	Acceptance Criteria			
		ICAL (%RSD)	ICV (% R)	LCS (%R)	CCV (%D)
Chloromethane	0.2	30	70 – 130	50 – 140	%D ≤ 40%
Vinyl Chloride	0.2	30	50 – 140	50 – 140	%D ≤ 40%
Ethanol	0.5	30	70 – 130	50 – 130*	%D ≤ 30%
1,1-Dichloroethene	0.2	30	70 – 130	70 – 130	%D ≤ 30%
Acetone	0.1	30	70 – 130	70 – 130	%D ≤ 30%
2-Propanol	0.1	30	50 – 130	50 – 130	%D ≤ 30%
MTBE	0.05	30	70 – 130	70 – 130	%D ≤ 30%
trans-1,2-Dichloroethene	0.1	20	80 – 120	70 – 130	%D ≤ 20%
Hexane	0.05	30	70 – 130	70 – 130	%D ≤ 30%
1,1-Dichloroethane	0.05	20	80 – 120	70 – 130	%D ≤ 20%
Ethyl Acetate	0.2	30	70 – 130	70 – 130	%D ≤ 30%
2-Butanone	0.05	30	70 – 130	70 – 130	%D ≤ 30%
cis-1,2-Dichloroethene	0.1	20	80 – 120	70 – 130	%D ≤ 20%
Chloroform	0.05	20	80 – 120	70 – 130	%D ≤ 20%
Cyclohexane	0.05	30	70 – 130	70 – 130	%D ≤ 20%
1,1,1-trichloroethane	0.05	20	80 – 120	70 – 130	%D ≤ 20%
Carbon Tetrachloride	0.05	20	80 – 120	70 – 130	%D ≤ 20%
Benzene	0.2	30	70 – 130	70 – 130	%D ≤ 30%
1,2-Dichloroethane	0.05	20	80 – 120	70 – 130	%D ≤ 20%
Heptane	0.05	20	80 – 120	70 – 130	%D ≤ 20%
Trichloroethene	0.05	20	80 – 120	70 – 130	%D ≤ 20%
4-Methyl-2-pentanone	0.1	30	70 – 130	70 – 130	%D ≤ 30%
Toluene	0.05	20	80 – 120	70 – 130	%D ≤ 20%
1,1,2-Trichloroethane	0.05	20	80 – 120	70 – 130	%D ≤ 20%
Tetrachloroethene	0.05	20	80 – 120	70 – 130	%D ≤ 20%
Chlorobenzene	0.05	20	80 – 120	70 – 130	%D ≤ 20%
Ethylbenzene	0.05	20	80 – 120	70 – 130	%D ≤ 20%
m,p-Xylene	0.05	20	80 – 120	70 – 130	%D ≤ 20%
o-Xylene	0.05	30	70 – 130	70 – 130	%D ≤ 20%
Styrene	0.05	30	70 – 130	20-100*	%D ≤ 30%

1,1,2,2-Tetrachloroethane	0.05	30	70 – 130	60 – 130	%D ≤ 30%
Propylbenzene	0.05	20	80 – 120	70 – 130	%D ≤ 20%
1,3,5-Trimethylbenzene	0.05	20	80 – 120	70 – 130	%D ≤ 20%
1,2,4-Trimethylbenzene	0.05	20	80 – 120	70 – 130	%D ≤ 20%
1,3-Dichlorobenzene	0.05	30	70 – 130	50 – 110**	%D ≤ 30%
1,4-Dichlorobenzene	0.05	30	70 – 130	50 – 110**	%D ≤ 30%
1,2-Dichlorobenzene	0.05	30	70 – 130	50 – 110**	%D ≤ 30%
Naphthalene	0.05	30	70 – 130	5-80*	%D ≤ 30%

*Acceptance limits based on desorption efficiency studies
**60 – 130% for WMS

Table 2. Internal Standard

Analyte	CCV IS (%R)	Sample IS (%)R
2-Fluorotoluene	50 – 200	50 – 200

Table 3. Surrogate

Analyte	%R
Toluene-d8	70-130

Table 4. Sampling Rates for "Standard" target compounds (RAD 130)

Analytes	Reporting Limit (µg/mL)	Reporting Limit (µg/sampler)	Sampling Rates for Radiello 130 Sampler (mL/min)
Chloromethane	0.2	0.4	107*
Vinyl Chloride	0.2	0.4	90*
Ethanol	0.5	1.0	102
1,1-Dichloroethene	0.2	0.4	76*
Acetone	0.1	0.2	77
2-Propanol	0.1	0.2	52
MTBE	0.05	0.1	65
trans-1,2-Dichloroethene	0.1	0.2	60*
Hexane	0.05	0.1	66
1,1-Dichloroethane	0.05	0.1	63*
Ethyl Acetate	0.2	0.4	78
2-Butanone	0.05	0.1	79
cis-1,2-Dichloroethene	0.05	0.1	62*
Chloroform	0.05	0.1	75
Cyclohexane	0.05	0.1	54
1,1,1-trichloroethane	0.05	0.1	62
Carbon Tetrachloride	0.05	0.1	67
Benzene	0.2	0.4	80
1,2-Dichloroethane	0.05	0.1	77
Heptane	0.05	0.1	58
Trichloroethene	0.05	0.1	69
4-Methyl-2-pentanone	0.1	0.2	67
Toluene	0.05	0.1	74

1,1,2-Trichloroethane	0.05	0.1	66*
Tetrachloroethene	0.05	0.1	59
Chlorobenzene	0.05	0.1	68
Ethylbenzene	0.05	0.1	68
m,p-Xylene	0.05	0.1	70
o-Xylene	0.05	0.1	65
Styrene	0.05	0.1	61
1,1,2,2-Tetrachloroethane	0.05	0.1	60*
Propylbenzene	0.05	0.1	57
1,3,5-Trimethylbenzene	0.05	0.1	53*
1,2,4-Trimethylbenzene	0.05	0.1	50
1,3-Dichlorobenzene	0.05	0.1	59*
1,4-Dichlorobenzene	0.05	0.1	51
1,2-Dichlorobenzene	0.05	0.1	58*
Naphthalene	0.05	0.1	25

*Estimated rate

Table 5. Sampling Rates for "Standard" target compounds (OVM)

Analytes	Reporting Limit (µg/mL)	Reporting Limit (µg/sampler)	Sampling Rates for OVM Sampler (mL/min)
Chloromethane	0.2	0.30	Estimated
Vinyl Chloride	0.2	0.30	41
Ethanol	0.5	0.75	44
1,1-Dichloroethene	0.2	0.30	Estimated
Acetone	0.1	0.15	40
2-Propanol	0.1	0.15	39
MTBE	0.05	0.075	38
trans-1,2-Dichloroethene	0.1	0.15	Estimated
Hexane	0.05	0.075	32
1,1-Dichloroethane	0.05	0.075	33
Ethyl Acetate	0.2	0.3	34
2-Butanone	0.05	0.075	36
cis-1,2-Dichloroethene	0.05	0.075	Estimated
Chloroform	0.05	0.075	34
Cyclohexane	0.05	0.075	32
1,1,1-trichloroethane	0.05	0.075	31
Carbon Tetrachloride	0.05	0.075	30
Benzene	0.2	0.30	80
1,2-Dichloroethane	0.05	0.075	33
Heptane	0.05	0.075	29
Trichloroethene	0.05	0.075	31
4-Methyl-2-pentanone	0.1	0.15	30
Toluene	0.05	0.075	31
1,1,2-Trichloroethane	0.05	0.075	30
Tetrachloroethene	0.05	0.075	28
Chlorobenzene	0.05	0.075	29
Ethylbenzene	0.05	0.075	27
m,p-Xylene	0.05	0.075	27

o-Xylene	0.05	0.075	27
Styrene	0.05	0.075	29
1,1,2,2-Tetrachloroethane	0.05	0.075	28
Propylbenzene	0.05	0.075	Estimated
1,3,5-Trimethylbenzene	0.05	0.075	Estimated
1,2,4-Trimethylbenzene	0.05	0.075	Estimated
1,3-Dichlorobenzene	0.05	0.075	Estimated
1,4-Dichlorobenzene	0.05	0.075	27.8
1,2-Dichlorobenzene	0.05	0.075	27.8
Naphthalene	0.05	0.075	25

Table 6. Sampling Rates for "Standard" target compounds (SKC Badge)

Analytes	Reporting Limit (µg/mL)	Reporting Limit (µg/sampler)	Sampling Rates for Indoor Air Applications 'Zero Face velocity' (mL/min)	Sampling Rates for Outdoor/Worker Exposure (mL/min)
Chloromethane	0.2	0.4	Estimated	Estimated
Vinyl Chloride	0.2	0.4	17.4*	21.2*
Ethanol	0.5	1.0	11.7	20.0
1,1-Dichloroethene	0.2	0.4	9.74	12.3
Acetone	0.1	0.2	12.6	15.2
2-Propanol	0.1	0.2	9.65	20.0
MTBE	0.05	0.1	9.84	13.6
trans-1,2-Dichloroethene	0.1	0.2	10.2	14.8
Hexane	0.05	0.1	9.59	14.3
1,1-Dichloroethane	0.05	0.1	13.14	12.3
Ethyl Acetate	0.2	0.4	9.26	13.75
2-Butanone	0.05	0.1	6.27	17.1
cis-1,2-Dichloroethene	0.05	0.1	11.54*	14.8*
Chloroform	0.05	0.1	10.14	13
Cyclohexane	0.05	0.1	7.76	15.6
1,1,1-trichloroethane	0.05	0.1	9.40	14.1
Carbon Tetrachloride	0.05	0.1	10.41	14.1
Benzene	0.2	0.4	10.69	16
1,2-Dichloroethane	0.05	0.1	11.79	14.2
Heptane	0.05	0.1	9.38	13.9
Trichloroethene	0.05	0.1	11.47	14.9
4-Methyl-2-pentanone	0.1	0.2	7.29	13.5
Toluene	0.05	0.1	8.90	14.5
1,1,2-Trichloroethane	0.05	0.1	9.64	12.5
Tetrachloroethene	0.05	0.1	10.02	13.1
Chlorobenzene	0.05	0.1	8.23*	18.74*
Ethylbenzene	0.05	0.1	9.02	12.9
m,p-Xylene	0.05	0.1	8.1	12.65
o-Xylene	0.05	0.1	8.11	11.9
Styrene	0.05	0.1	9.04	13.7
1,1,2,2-Tetrachloroethane	0.05	0.1	9.98	11.8
Propylbenzene	0.05	0.1	6.41*	11.69*
1,3,5-Trimethylbenzene	0.05	0.1	7.29*	12.1*

1,2,4-Trimethylbenzene	0.05	0.1	9.92*	12.1*
1,3-Dichlorobenzene	0.05	0.1	5.79*	12.7*
1,4-Dichlorobenzene	0.05	0.1	10.74*	12.7*
1,2-Dichlorobenzene	0.05	0.1	4.97*	12.6*
Naphthalene	0.05	0.1	2.71*	13.7*

*Calculated by SKC

Table 7. Summary of Calibration and QC Procedures

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Prior to calibration and at the start of every 12-hour clock	Method 8260B tuning criteria	Correct problem then repeat tune.
Initial 5-Point Calibration (ICAL)	Prior to sample analysis	Compound criteria in Table 1	Correct problem then repeat initial calibration. Analysis may proceed if no more than 2 VOCs exceed criteria or 5% of VOCs if short list is used. Narrate exceedances.
Initial Calibration Verification (ICV)	Once per initial calibration	See Table 1	Verify concentrations and standard preparation. Analysis may proceed if no more than 2 VOCs exceed criteria or 5% of VOCs if short list is used. Narrate exceedances.
Continuing Calibration Verification (CCV)	At the start of every shift immediately after the BFB tune check	See "CCV criteria" column in Table 1	Investigate and correct the problem, up to and including recalibration if necessary. Analysis may proceed if no more than 2 VOCs exceed criteria or 5% of VOCs if short list is used. Associated results are flagged.
Internal Standards (IS)	IS is added at the time of extraction to all samples and QC samples.	**For CCVs:** Area counts 50 –200%; RT w/in 30 seconds of midpoint in ICAL **For blanks, samples and non-CCV QC checks:** Area counts 50 – 200%; RT within 20 seconds of RT in CCV	**CCV:** Inspect and correct system prior to sample analysis. **For blanks:** Inspect the system and re-analyze the blank. **For samples:** Re-analyze; if out again, flag data.
Surrogate	Surrogate is added at the time of extraction to all samples and QC samples.	70–130%	Same as for Internal Standards.
Solvent Blanks	Immediately after the calibration standard or after samples with high concentrations	Results less than laboratory reporting limit (see Table 1)	Re-aliquot and re-analyze solvent blank. If detections remain, flag concentrations in associated samples.

Extracted Laboratory Blank	Each set of up to 20 samples	Results less than the reporting limit	Flag sample concentrations in associated extraction batch.
Extracted Laboratory Control Spike (LCS)	Each set of up to 20 samples	See Table 1.	Re-aliquot and re-analyze the extract. If within limits, report the re-analysis. Otherwise, narrate.
Extracted Laboratory Control Spike Duplicate (LCSD)	Each set of up to 20 samples	%RPD ≤ 25%	Analysis may proceed if no more than 2 VOCs exceed criteria (or 5% for short list exceed criteria). Run a 3rd time; perform corrective action or narrate as appropriate.

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LABORATORY QUALITY ASSURANCE MANUAL

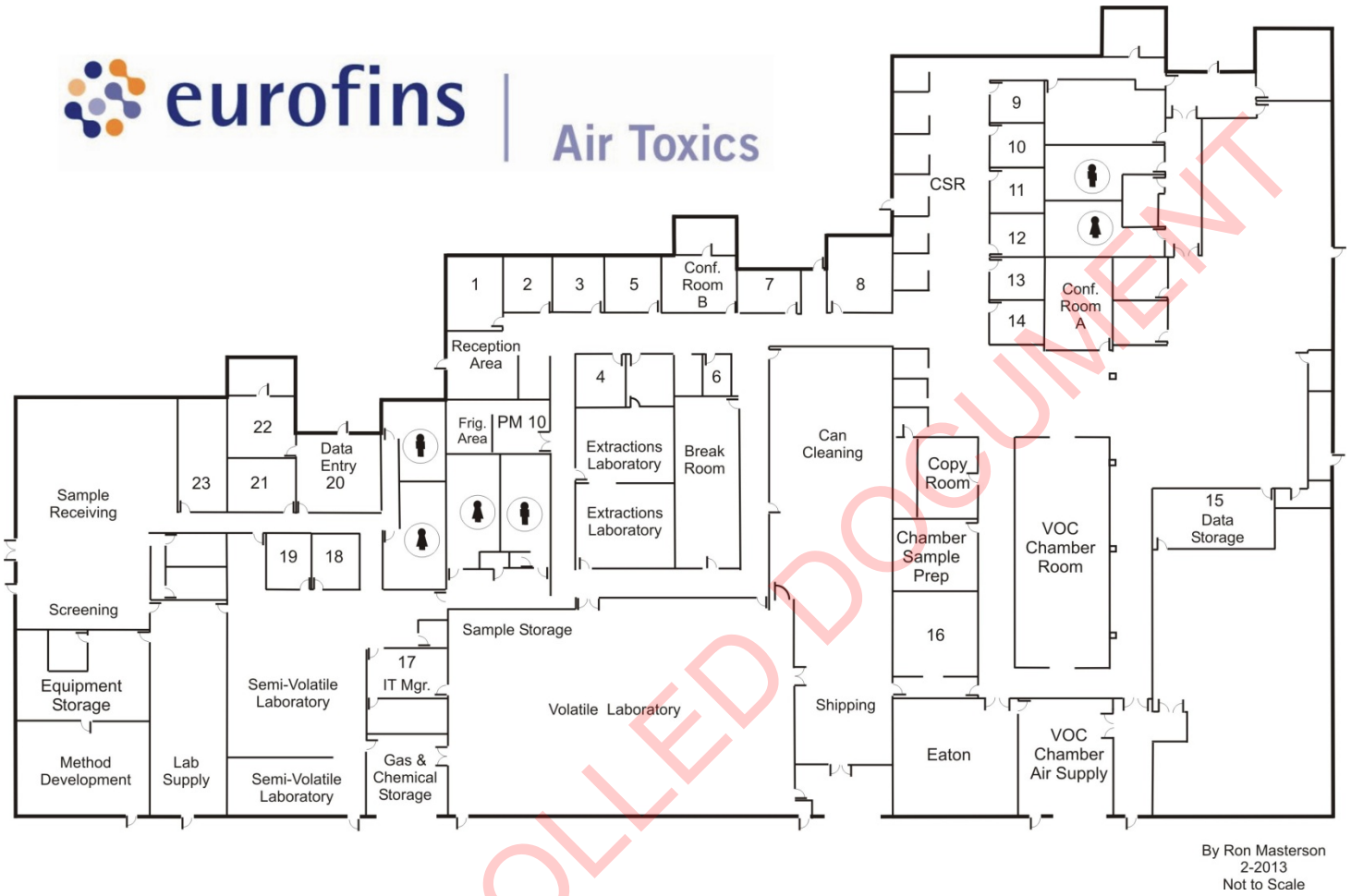
(LQAM)

Appendix F

Facility Map

(Two total pages including this cover)

Current as of March 5, 2014



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LABORATORY QUALITY ASSURANCE MANUAL

(LQAM)

Appendix G

References

(Two total pages including this cover)

Current as of March 5, 2014

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OREGON

Environmental Laboratory Accreditation Program

NELAP Recognized

Eurofins Air Toxics, Inc

CA300005

180 Blue Ravine Road, Ste. B

Folsom,CA 95630

IS GRANTED APPROVAL BY ORELAP UNDER THE 2009 TNI STANDARDS, TO PERFORM ANALYSES ON ENVIRONMENTAL SAMPLES IN MATRICES AS LISTED BELOW :

Air	*Drinking Water*	*Non Potable Water*	*Solids and Chem. Waste*	*Tissue*
Chemistry				

AND AS RECORDED IN THE LIST OF APPROVED ANALYTES, METHODS, ANALYTICAL TECHNIQUES, AND FIELDS OF TESTING ISSUED CONCURRENTLY WITH THIS CERTIFICATE AND REVISED AS NECESSARY.

ACCREDITED STATUS DEPENDS ON SUCCESSFUL ONGOING PARTICIPATION IN THE PROGRAM AND CONTINUED COMPLIANCE WITH THE STANDARDS.

CUSTOMERS ARE URGED TO VERIFY THE LABORATORY'S CURRENT ACCREDITATION STATUS IN OREGON.

Gary K. Ward

Gary K. Ward, MS

Oregon State Public Health Laboratory

ORELAP Administrator

3150 NW. 229th Ave, Suite 100

Hillsboro, OR 97124

ISSUE DATE: 10/18/2013

EXPIRATION DATE: 10/17/2014

Certificate No: CA300005 - 004

Oregon

Environmental Laboratory Accreditation Program

Department of Agriculture, Laboratory Division
Department of Environmental Quality, Laboratory Division
Oregon Health Authority, Public Health Division

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ORELAP Fields of Accreditation

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Eurofins Air Toxics, Inc

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Issue Date: 10/18/2013 ***Expiration Date:*** 10/17/2014

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MATRIX : Air

Reference	Code	Description
ASTM D1945 03	**30024443**	**Natural Gas by Gas Chromatography**

Analyte Code	*Analyte*
4938	2-Methylbutane (Isopentane)
4942	2-methylpropane (Isobutane)
4323	Acetylene
3755	Carbon dioxide
3780	Carbon monoxide
4747	Ethane
4752	Ethene
1767	Helium
1772	Hydrogen
4926	Methane
5007	n-Butane
9511	Neopentane
1843	Nitrogen
5028	n-Pentane
5029	n-Propane
3895	Oxygen

ASTM D1946-90	**30024465**	**Reformed Gas by Gas Chromatography**

Analyte Code	*Analyte*
3755	Carbon dioxide
3780	Carbon monoxide
4747	Ethane
4752	Ethene
1767	Helium
1772	Hydrogen
4926	Methane
1843	Nitrogen
3895	Oxygen

ASTM D5504 08	**30032258**	**Determination of Sulfur Compounds in Natural Gas and Gaseous Fuels by Gas Chromatography and Chemiluminescence**

Analyte Code	*Analyte*
4842	1-Propanethiol
6113	2,5-Dimethylthiophene
4544	2-Ethylthiophene
4843	2-Propanethiol
5783	3-Methylthiophene
4450	Carbon disulfide

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Analyte Code	*Analyte*
7215	Carbonyl sulfide
6078	Diethyl Disulfide
6081	Diethyl Sulfide
4729	Dimethyl disulfide
6116	Dimethyl Sulfide
7506	Ethanethiol
3840	Hydrogen sulfide
3725	i-Butanethiol
7507	Methanethiol
9556	t-Butanethiol
9574	Tetrahydrothiophene
9578	Thiophene

EPA TO-10A (GC/ECD) **10247504** **Pesticides and PCBs with HV PUF by GC/ECD**

Analyte Code	*Analyte*
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
8880	Aroclor-1016 (PCB-1016)
8890	Aroclor-1232 (PCB-1232)
8895	Aroclor-1242 (PCB-1242)
8900	Aroclor-1248 (PCB-1248)
8905	Aroclor-1254 (PCB-1254)
8910	Aroclor-1260 (PCB-1260)
7115	beta-BHC (beta-Hexachlorocyclohexane)
7250	Chlordane (tech.)
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
7810	Methoxychlor
8250	Toxaphene (Chlorinated camphene)

EPA TO-11A **10311805** **Determination of Formaldehyde in Ambient Air Using Adsorbent Cartridge Followed by High Performance Liquid Chromatography (HPLC)**

Analyte Code	*Analyte*
4300	Acetaldehyde
4315	Acetone
5570	Benzaldehyde
4430	Butylaldehyde (Butanal)
4545	Crotonaldehyde
4815	Formaldehyde
3825	Hexanaldehyde (Hexanal)
6330	Isovaleraldehyde
5125	m-Tolualdehyde (1,3-Tolualdehyde)
6755	o-Tolualdehyde (1,2-Tolualdehyde)
3965	Propionaldehyde (Propanal)
6760	p-Tolualdehyde (1,4-Tolualdehyde)
4040	Valeraldehyde (Pentanal, Pentanaldehyde)

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EPA TO-12 **10248201** **Non-Methane Organic Compounds by GC/FID**

Analyte Code	*Analyte*
3860	Non-methane organics

EPA TO-13A **10248405** **Polycyclic Aromatic Hydrocarbons in Ambient Air by GC/MS**

Analyte Code	*Analyte*
5795	2-Chloronaphthalene
6385	2-Methylnaphthalene
5500	Acenaphthene
5505	Acenaphthylene
5555	Anthracene
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5605	Benzo(e)pyrene
5590	Benzo(g,h,i)perylene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5855	Chrysene
5895	Dibenz(a,h) anthracene
6265	Fluoranthene
6270	Fluorene
6315	Indeno(1,2,3-cd) pyrene
5005	Naphthalene
6615	Phenanthrene
6665	Pyrene

EPA TO-13A SIM **10248449** **Polycyclic Aromatic Hydrocarbons in Ambient Air by GC/MS SIM**

Analyte Code	*Analyte*
6380	1-Methylnaphthalene
5795	2-Chloronaphthalene
6385	2-Methylnaphthalene
5500	Acenaphthene
5505	Acenaphthylene
5555	Anthracene
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5605	Benzo(e)pyrene
5590	Benzo(g,h,i)perylene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5855	Chrysene
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
6265	Fluoranthene
6270	Fluorene
6315	Indeno(1,2,3-cd) pyrene
6615	Phenanthrene
6665	Pyrene

EPA TO-14A **10248609** **Volatile Organic Compounds with SUMMA canister and GC/MS**

Analyte Code	*Analyte*
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
5165	1,1,2-Trichloroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene

ORELAP Fields of Accreditation

ORELAP ID: CA300005
EPA CODE: CA00933
Certificate: CA300005 - 004

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Analyte Code	*Analyte*
5155	1,2,4-Trichlorobenzene
5210	1,2,4-Trimethylbenzene
4585	1,2-Dibromoethane (EDB, Ethylene dibromide)
4695	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
5215	1,3,5-Trimethylbenzene
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
4836	1-Propene
4860	2-Hexanone
4542	4-Ethyltoluene
4315	Acetone
4375	Benzene
5635	Benzyl chloride
4395	Bromodichloromethane
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform
4705	cis & trans-1,2-Dichloroethene
4680	cis-1,3-Dichloropropene
4555	Cyclohexane
4625	Dichlorodifluoromethane (Freon-12)
4750	Ethanol
4765	Ethylbenzene
4835	Hexachlorobutadiene
4895	Isopropyl alcohol (2-Propanol, Isopropanol)
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
4975	Methylene chloride (Dichloromethane)
5005	Naphthalene
4825	n-Heptane
4855	n-Hexane
5090	n-Propylbenzene
5100	Styrene
5115	Tetrachloroethylene (Perchloroethylene)
5120	Tetrahydrofuran (THF)
5140	Toluene
4685	trans-1,3-Dichloropropylene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5235	Vinyl chloride
5260	Xylene (total)

EPA TO-15 **10248803** **VOCs collected in Canisters by GC/MS**

Analyte Code	*Analyte*
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
5165	1,1,2-Trichloroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene
5155	1,2,4-Trichlorobenzene
5210	1,2,4-Trimethylbenzene
4585	1,2-Dibromoethane (EDB, Ethylene dibromide)
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)

ORELAP Fields of Accreditation

ORELAP ID: CA300005
EPA CODE: CA00933
Certificate: CA300005 - 004

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Analyte Code	*Analyte*
4655	1,2-Dichloropropane
5215	1,3,5-Trimethylbenzene
9318	1,3-Butadiene
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
4735	1,4-Dioxane (1,4- Diethyleneoxide)
4836	1-Propene
5220	2,2,4-Trimethylpentane
4410	2-Butanone (Methyl ethyl ketone, MEK)
4860	2-Hexanone
4542	4-Ethyltoluene
4995	4-Methyl-2-pentanone (MIBK)
4315	Acetone
4325	Acrolein (Propenal)
4355	Allyl chloride (3-Chloropropene)
4375	Benzene
5635	Benzyl chloride
4395	Bromodichloromethane
4400	Bromoform
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform
4705	cis & trans-1,2-Dichloroethene
4680	cis-1,3-Dichloropropene
4555	Cyclohexane
4625	Dichlorodifluoromethane (Freon-12)
4750	Ethanol
4765	Ethylbenzene
4835	Hexachlorobutadiene
4895	Isopropyl alcohol (2-Propanol, Isopropanol)
4900	Isopropylbenzene
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5005	Naphthalene
4825	n-Heptane
4855	n-Hexane
5090	n-Propylbenzene
5100	Styrene
5115	Tetrachloroethylene (Perchloroethylene)
5120	Tetrahydrofuran (THF)
5140	Toluene
4685	trans-1,3-Dichloropropylene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5225	Vinyl acetate
5235	Vinyl chloride
5260	Xylene (total)

EPA TO-15 GC/MS SIM **10248858** **VOCs collected in Canisters by GC/MS SIM**

Analyte Code	*Analyte*
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
5165	1,1,2-Trichloroethane
4630	1,1-Dichloroethane

ORELAP Fields of Accreditation

ORELAP ID: CA300005
EPA CODE: CA00933
Certificate: CA300005 - 004

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Analyte Code	*Analyte*
4640	1,1-Dichloroethylene
5155	1,2,4-Trichlorobenzene
5210	1,2,4-Trimethylbenzene
4585	1,2-Dibromoethane (EDB, Ethylene dibromide)
4695	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
5215	1,3,5-Trimethylbenzene
9318	1,3-Butadiene
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
4410	2-Butanone (Methyl ethyl ketone, MEK)
4860	2-Hexanone
4542	4-Ethyltoluene
4995	4-Methyl-2-pentanone (MIBK)
4315	Acetone
4375	Benzene
5635	Benzyl chloride
4395	Bromodichloromethane
4400	Bromoform
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform
4645	cis-1,2-Dichloroethylene
4680	cis-1,3-Dichloropropene
4625	Dichlorodifluoromethane (Freon-12)
4765	Ethylbenzene
5240	m+p-xylene
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5005	Naphthalene
4825	n-Heptane
4855	n-Hexane
5250	o-Xylene
5100	Styrene
5115	Tetrachloroethylene (Perchloroethylene)
5140	Toluene
4700	trans-1,2-Dichloroethylene
4685	trans-1,3-Dichloropropylene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5235	Vinyl chloride

EPA TO-17 **10312206** **Determination of Volatile Organic Compounds in Ambient Air Using Active Sampling Onto Sorbent Tubes**

Analyte Code	*Analyte*
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
5165	1,1,2-Trichloroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene
5155	1,2,4-Trichlorobenzene
5210	1,2,4-Trimethylbenzene
4695	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)

ORELAP Fields of Accreditation

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Analyte Code	*Analyte*
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
5215	1,3,5-Trimethylbenzene
9318	1,3-Butadiene
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
4735	1,4-Dioxane (1,4- Diethyleneoxide)
6380	1-Methylnaphthalene
5220	2,2,4-Trimethylpentane
4410	2-Butanone (Methyl ethyl ketone, MEK)
4860	2-Hexanone (MBK)
4938	2-Methylbutane (Isopentane)
6385	2-Methylnaphthalene
4542	4-Ethyltoluene
4910	4-Isopropyltoluene (p-Cymene)
5500	Acenaphthene
5505	Acenaphthylene
5555	Anthracene
4375	Benzene
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform
4645	cis-1,2-Dichloroethylene
4555	Cyclohexane
4765	Ethylbenzene
6265	Fluoranthene
6270	Fluorene
4835	Hexachlorobutadiene
4895	Isopropyl alcohol (2-Propanol, Isopropanol)
4900	Isopropylbenzene
5240	m+p-xylene
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4965	Methylcyclohexane
4975	Methylene chloride (Dichloromethane)
5005	Naphthalene
4435	n-Butylbenzene
4825	n-Heptane
4855	n-Hexane
5090	n-Propylbenzene
5250	o-Xylene
6615	Phenanthrene
6665	Pyrene
4440	sec-Butylbenzene
5100	Styrene
5115	Tetrachloroethylene (Perchloroethylene)
5140	Toluene
4700	trans-1,2-Dichloroethylene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5235	Vinyl chloride
5260	Xylene (total)

ORELAP Fields of Accreditation

ORELAP ID: CA300005
EPA CODE: CA00933
Certificate: CA300005 - 004

Eurofins Air Toxics, Inc

180 Blue Ravine Road, Ste. B
Folsom CA 95630

Issue Date: 10/18/2013 ***Expiration Date:*** 10/17/2014

As of 10/18/2013 ***this list supercedes all previous lists for this certificate number.***
Customers. Please verify the current accreditation standing with ORELAP.

EPA TO-3 **10249000** **Cryogenic Trapping**

Analyte Code	*Analyte*
4375	Benzene
4765	Ethylbenzene
5140	Toluene
5260	Xylene (total)

EPA TO-4A **10249204** **Pesticides and PCBs by HV PUF GC**

Analyte Code	*Analyte*
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
8880	Aroclor-1016 (PCB-1016)
8890	Aroclor-1232 (PCB-1232)
8895	Aroclor-1242 (PCB-1242)
8900	Aroclor-1248 (PCB-1248)
8905	Aroclor-1254 (PCB-1254)
8910	Aroclor-1260 (PCB-1260)
7115	beta-BHC (beta-Hexachlorocyclohexane)
7250	Chlordane (tech.)
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
7810	Methoxychlor
8250	Toxaphene (Chlorinated camphene)

Appendix D
Instrumentation Descriptions

Outdoor Hi-Volume Air Samplers

- Automatic/PID Mass or Volumetric Flow Control
- Networking & Communication Capabilities
- Continuous Data Logging
- Auto Calibration feature
- Programmable Timer & Total Volume Shut-Off
- Brushless 2 or 3 Stage Blower Motor
- For Continuous Use/Maintenance Free
- Applicable to EPA's 40 CFR 50, App. B
- PM-10 Head Adaptable

High volume air samplers are housed in a clear anodized aluminum outdoor shelter. The units incorporate a maintenance-free, two or three stage centrifugal blower powered by a brushless, variable speed, maintenance free motor. Blower selection is dependent upon individual sampling environment. The speed of the motor is controlled by a programmable logic controller (PLC) that accepts an input from a mass or volumetric flow sensor mounted in the sample air flow stream. The PLC detects changes in the operator's pre-set flow rate due to changes in temperature, barometric pressure and pressure drop due to dust loading on filter media. It compensates for these changes by adjusting the motor speed to maintain the pre-set flow rate. The illuminated, graphic LCD displays the operator's Pre-Set Flow Rate, Instantaneous Flow Rate, Total Volume of Air Sampled, and Elapsed Sample Time. The PLC also allows for programming of custom sample on/off time settings & pre-set total volume shut off. Networking and Communication option set-ups include: two (selectable) RS232/RS485 ports, a 4-20 mA and/or 0-10 VDC analog output proportional to flow, the ability to send & receive SMS messages to/from any CDMA/GSM cellular phone for possibly alerting/reporting any pre-defined event via text message, remote or local data acquisition, data logging in MS Excel format, and a custom remote access utility that allows complete control of the unit from a remote location.

HI-Volume Air Flow Calibrator

HI-Volume Air Flow calibrators have eliminated the need for cumbersome orifice plates and water manometers. The units utilize a precision machined Venturi tube coupled with a pressure differential gauge giving a direct reading in the volumetric units of choice (i.e. SCFM @ stp). It is calibrated against an in-line N.I.S.T. traceable laminar flow element. The primary calibrator meets the requirements of MIL Std. 45662A. They are intended to be used open to air. The direct meter read-out will indicate the flow in standard CFM, LPM, or CMM at standard conditions (29.92" of Hg and 70º F). Given actual sampling temperature & barometric pressure during calibration, a technician can convert actual flow readings (i.e. ACFM) to standard units (i.e. SCFM) by making a simple calculation using look-up correction factors from tables given in the operating manual. An operator is able to calibrate a unit with a 4" diameter filter holder assembly.

Calibration Adapter Plates (High Flow)

Adapters are designed to reduce overall pressure drop found during the calibration of standard 4" diameter and 8" x 10" filter paper sampling applications. The FHA's unique design reduces the overall paper to adapter fitting contact, thereby allowing the maximum obtainable free cross-sectional surface area through which unrestricted air can pass. This is done to duplicate the conditions of ambient air, open face, sampling procedures and to reduce the overall error in calibration.

Filter Paper for Air Sampling

Glass fiber filter media is made from 100% micro-fine borosilicate glass fibers. Glass fiber filters are used where high flow rate and micron/sub-micron filtration is required. The filter media can be used for both liquid and air filtration. In the highest purity form, HI-Q offers a binderless "AE" grade glass filter media.

Properties of Glass Fiber Media: The borosilicate glass fibers are inert and resistant to all but strongly alkaline bases or acids such as hydrofluoric acid. The fibers are heat resistant and will only begin to soften at over 600°C. The borosilicate glass has a refractive index of 1.51, and when immersed in a solvent of a similar refractive index like benzene, the fibers will be transparent. Particles collected on the media then become easier to visibly identify.

Radiation Dosimeter (TLD)

The standard TLD dosimeter card consists of a coded slide placed in a slide holder, with or without fi lters, and carried inside the dosimeter cover. The slide has four positions for the detectors (pellets, chips or rods). The detectors are not attached to the slide positions and any required number of positions up to four can be used.This makes it possible to handle the elements separately (e.g. extremity or clinical dosimetry).

Alpha Track Detector for Radon Gas

A radon monitor is a diffusion-based long-term alpha track detector. The detector is composed of a sealed plastic chamber which holds a specially manufactured plastic chip called CR-39. Radon enters the chamber through a seam around the circumference of the device, preventing dust and other particles from entering. Each detector has a unique serial number for tracking and satisfies chain of custody requirements.

After choosing an appropriate testing location, the detector is removed from its pouch to begin exposure. As radon gas diffuses into the chamber, it begins radioactive decay. Alpha particle emissions make "tracks" or etchings on the plastic chip in the chamber. After an exposure period of three months to one year, the detector is placed back in the pouch and returned to the laboratory for analysis by etching and magnified image track counting.

Radiello Diffusive Sampling System

The use of passive or diffusive air sampling technology has gained in popularity over the last 20 years. Unlike active sampling, passive samplers require no electricity (expensive pumps), have no moving parts, and are simple to use (no pump operation/calibration).

Other benefits of passive/diffusive sampling include:

- Compact, portable, unobtrusive, and inexpensive
- Offers indication of average pollution levels over time periods of 8 hours to weeks/months
- Requires no supervision, non-flammable, and noiseless
- Low cost allows sampling at a number of locations
- For highlighting pollutant “hotspots” where detailed study may be needed
- For determining long term data trends in specific geographical areas such as industrial zones
- Amenable to personal monitoring “breathing zone”, indoor air analysis, and outdoor ambient air analysis

05305L Wind Monitor-AQ, 4-20 mA Outputs

This Wind Monitor is a high resolution wind sensor designed specifically for air quality applications. It combines simple, corrosion-resistant construction with low threshold, fast response, and excellent fidelity. Wind speed is sensed by a lightweight, carbon fiber thermoplastic (CFT), helicoid propeller. Propeller rotation produces an AC sine wave voltage signal with frequency directly proportional to wind speed. Slip rings and brushes are not used. The instrument body is UV stabilized plastic with stainless steel and anodized aluminum fittings. Precision grade, stainless steel ball bearings are used throughout.

The wind direction sensor is a lightweight vane with performance characteristics that assure excellent fidelity in fluctuating wind conditions. Vane position is sensed by a precision potentiometer. Output is a DC voltage directly proportional to vane angle. The Wind Monitor-AQ meets the requirements of the following regulatory agencies: U.S. Environmental Protection Agency-Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD). U.S. Nuclear Regulatory Agency-NRC Regulatory Guide 1.23 Meteorological Programs in Support of Nuclear Power Plants. American Nuclear Society-Standard for Determining Meteorological Information at Power Plants.

Appendix E
eurofins Air Toxics Radiello 130
Reporting Limits

RAD 130 SE

Duration		
Days	Hours	Minutes
14	0	0

Total Duration (min)

20160

Full List Target Analytes	**Reporting Limit (ug/m3)**	**Reporting Limit Flag**
1,1,1-Trichloroethane	0.0800	
1,2-Dichloroethane	0.0644	
1,4-Dichlorobenzene	0.0973	
2-Butanone (Methyl Ethyl Ketone)	0.0628	
2-Propanol	0.1908	
4-Methyl-2-pentanone	0.1481	
Acetone	0.1288	
Benzene	0.2480	
Carbon Tetrachloride	0.0740	
Chlorobenzene	0.0729	
Chloroform	0.0661	
Cyclohexane	0.0919	
Ethanol	0.4863	
Ethyl Acetate	0.2544	
Ethyl Benzene	0.0729	
Heptane	0.0855	
Hexane	0.0752	
m,p-Xylene	0.0709	
Methyl tert-butyl ether	0.0763	
Naphthalene	0.1984	
o-Xylene	0.0763	
Propylbenzene	0.0870	
Styrene	0.0813	
Tetrachloroethene	0.0841	
Toluene	0.0670	
Trichloroethene	0.0719	
1,2,4-Trimethylbenzene	0.0992	

Appendix F
Target Volatile Organic Compounds

Method: Passive SE GC/MS - Full 130

Compound	Rpt.Limit(ug)	Rpt Limit (ug/m3 – 30 day exposure)
Ethanol	1.0	0.23
Acetone	0.20	0.06
2-Propanol	0.20	0.09
Methyl tert-butyl ether	0.10	0.04
Hexane	0.10	0.04
Ethyl Acetate	0.40	0.12
2-Butanone (Methyl Ethyl Ketone)	0.10	0.03
Chloroform	0.10	0.03
1,1,1-Trichloroethane	0.10	0.04
Cyclohexane	0.10	0.04
Carbon Tetrachloride	0.10	0.03
Benzene	0.40	0.12
1,2-Dichloroethane	0.10	0.03
Heptane	0.10	0.04
Trichloroethene	0.10	0.03
4-Methyl-2-pentanone	0.20	0.07
Toluene	0.10	0.03
Tetrachloroethene	0.10	0.04
Chlorobenzene	0.10	0.03
Ethyl Benzene	0.10	0.03
m,p-Xylene	0.10	0.03
o-Xylene	0.10	0.04
Styrene	0.10	0.04
Propylbenzene	0.10	0.04
1,4-Dichlorobenzene	0.10	0.05
Naphthalene	0.10	0.09

Surrogate	Method Limits
Toluene-d8	70-130